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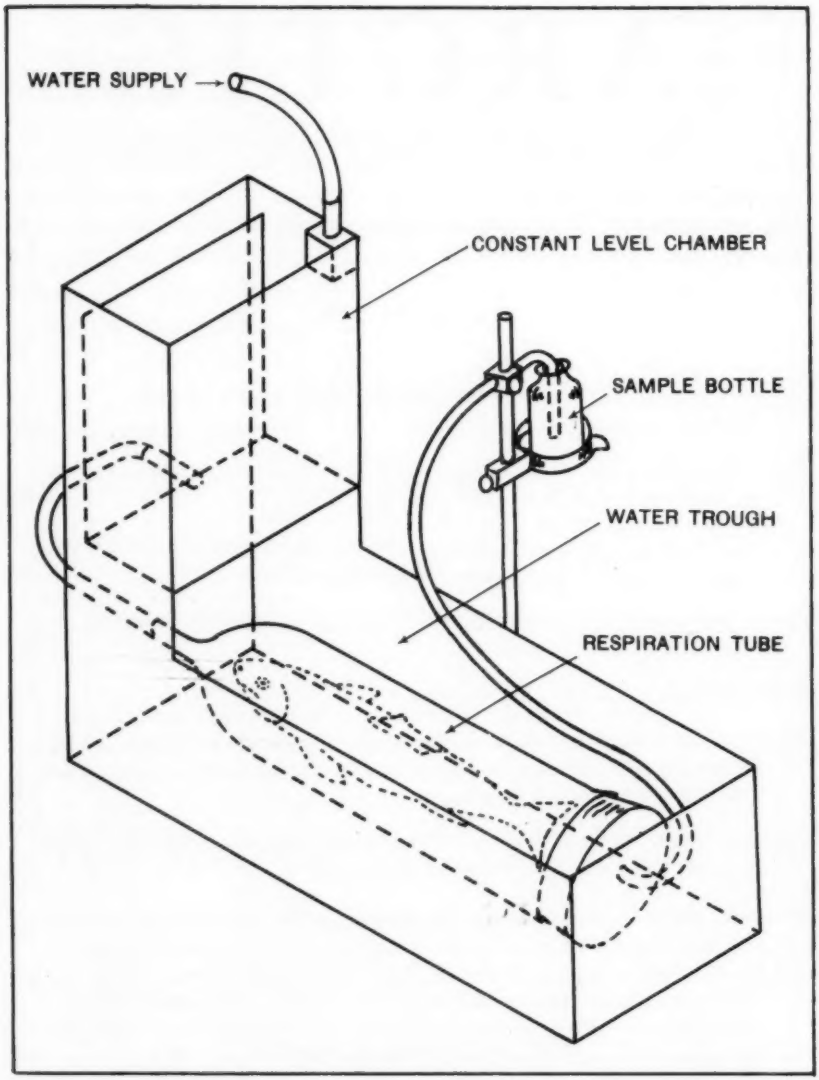

Fig. 1. Details of continuous-flow apparatus used for measuring the oxygen consumption of young salmon.

FIELD MEASUREMENTS OF THE BASAL OXYGEN CONSUMPTION OF ATLANTIC SALMON PARR AND SMOLTS

G. Power*

THIS investigation was undertaken in order to study, under conditions as nearly natural as possible, the basal oxygen requirements of salmon parr and smolts living at the northern limit of their range in Ungava. The results are of interest for two reasons; (1) an indication is obtained of the way the salmon's metabolism responds to temperature changes in its environment; (2) a point of reference is provided which, when other suitable figures are available, may be used to detect possible adaptation to cold in the metabolism of northern races of salmon.

To date almost all measurements of the oxygen consumption of fish have been made in the laboratory, for the obvious reason that many of the variables inherent in the natural environment can be eliminated or controlled. From the results of such studies the behaviour of fish in nature can be predicted within limits. Caution must be exercised in doing this, since controlled laboratory conditions tend to be quite different from natural conditions where a fish is subjected to daily and seasonal fluctuations in temperature, oxygen concentration, light, food supply, and to other not so apparent changes. By carrying out measurements of oxygen consumption in the field these variations can be incorporated into the experiments, reducing to a minimum any disturbance of the fish. The physiological condition of an organism, influenced by the normal vicissitudes of its environment will be affected by changes from the normal, and results of field experiments are of value as an estimate of the natural behaviour of an organism no matter how difficult it is to interpret them. Temperature is undoubtedly the most important variable affecting the oxygen consumption of an organism in the natural environment and those inhabiting rivers are unable to avoid exposure to temperature fluctuations, which in Ungava often reach 3°C. daily, superimposed on a seasonal cycle with a range of approximately 15°C.

For studies of climatic adaptation, field experiments are indispensable. Lindroth (1942) gives figures for the oxygen consumption of young salmon, but his figures are so much greater than those obtained in the present study (40-gm. parr using approximately 0.080 ml. O_2/gm./hr. at 10°C. as against 0.061 ml. O_2/gm./hr. at 10°C. for an Ungava parr of equivalent weight) that comparison is not possible. The study of adaptation to cold of the

* Assistant Professor of Zoology, University of Waterloo.

basal metabolism in Ungava salmon must wait until more information is available from other regions.

Material and method

Source of material

Fish used in the experiments were taken from the George River at Helen Falls or from the Kaniapiskau tributary of the Koksoak River below Manitou Gorge. Generally a Fyke net was used to capture the fish and they were retained in the net for 24 hrs. before an experiment. Occasionally fish taken by hand net or by rod and line were used and then particular care was taken to see that the fish were not more than superficially injured at capture and they were retained in keep pools adjacent to the site of capture for a few days before being used in an experiment.

Method

Of the methods available for determining the oxygen consumption of poikilotherms (see Fry 1957) the continuous flow method has obvious advantages in the field. Water of known oxygen concentration is passed through a chamber containing the experimental organism and the overflow is collected to determine the amount of oxygen extracted and the rate of flow through the apparatus. By passing water taken directly from the river through the apparatus all changes in the river are immediately duplicated in the apparatus. Experiments can be continued over an indefinite period of time during the whole of which determinations of oxygen consumption can be made. In experiments with species of fish that usually inhabit running water the flow of fresh water over the animal possibly assists in keeping it tranquil by reproducing its ecological norm. In measuring basal metabolism it is particularly important that all activity be reduced to a minimum.

The apparatus itself is a simplification of that used by Keys (1930). Water is obtained upstream from the apparatus, and piped to the constant-level chamber (Fig. 1). The water that overflows from this chamber falls into the water trough, flows past the respiration tube and spills over the lower end of the trough. A small rubber tube carries water from the lower end of the constant-level chamber and delivers it to the respiration chamber in which the experimental fish is enclosed. Water flows through this chamber, past the fish and through the outflow tube into the sample bottle. The rate of flow through the respiration chamber can be regulated by altering the height of the sample bottle in relation to the level of the constant-level chamber. The overflow from the sample bottle is collected in a shallow tray and directed into a short spout. The rate of flow through the respiration chamber can be measured by collecting the overflow for a known period of time. In practice this was one minute during which between 50 and 90 ml. were delivered into a 100-ml. measuring cylinder.

Oxygen determinations, using the unmodified Winkler method, were carried out on water collected in the sample bottle, which was replaced hourly during an experiment, and simultaneously on a sample of water taken from the tube supplying the constant-level chamber. The unmodified Winkler method of oxygen determination is generally adopted for work of this nature and gives entirely satisfactory results in the waters of lakes and streams that do not contain high concentrations of iron, nitrates or organic matter.

Certain precautions were taken to prevent disturbing the fish during an experiment. The apparatus, which was constructed of plexiglass, was covered with a dark cloth that restricted the vision of the fish. The bottom of the water trough was covered with clean river gravel so that conditions in the respiration tube resembled as closely as possible the environment of a fish lying quietly under a rock on the river bed. The hose supplying water to the apparatus was immersed in the river for its whole length to prevent warming of the water in the hose on a hot day and the apparatus itself was partly submerged in the river and located in the shade to prevent warming by the sun.

In a typical experiment the fish was placed in the apparatus in the evening and given the following night to settle down and become accustomed to confinement in the respiration chamber. The size of the chamber was chosen to allow the fish room for restricted movement. If the chamber is too small the fish is unable to move sufficiently to maintain normal equilibrium and often falls over on one side and remains in an excited condition. Sampling was begun the next morning, usually 2 hours after sunrise and continued at hourly intervals until about noon. Six samples were considered desirable in each experiment.

At least 6 hours should elapse between placing the fish in the respiration chamber and beginning to measure the basal oxygen consumption. Handling the fish is sufficient to cause it to respire at a maximal rate for some time, after which the rate gradually falls to a minimum (Keys 1930, Wells 1932). This was confirmed in a number of experiments in which the oxygen consumption was determined at intervals beginning immediately after the fish was introduced into the apparatus. Fig. 2 shows the results of one such experiment carried out on a salmon parr and typical of the pattern found: a high initial rate that falls rapidly during the first 2 hours until a basal level is reached, usually after 3 to 4 hours. Sometimes fish never settled down, or became disturbed during the course of an experiment. The commonest causes of excitement were either loss of equilibrium or the passing of faeces. Faeces caused a certain amount of trouble in that they occasionally obstructed the flow of water through the apparatus. One further cause of trouble was supersaturation of the water. This happened at only one locality in Manitou Gorge, where bubbles of gas came out of solution in the apparatus and often blocked the smaller tubes. Experiments in which disturbances occurred were abandoned and disregarded.

Results and discussion

The juvenile salmon were divided into two groups, parr and smolts, and an attempt was made to keep these groups quite distinct and fairly uniform in size. Experiments were conducted on 11 parr and 20 smolts, from both the George and Koksoak rivers. For complete details of each experiment see Power (1959). The mean weight of the parr was 42.5 gms., standard deviation 11.2, and that of the smolts was 80.0 gms., standard deviation 9.9. Experiments were conducted at temperatures from 4°C. to 16°C.

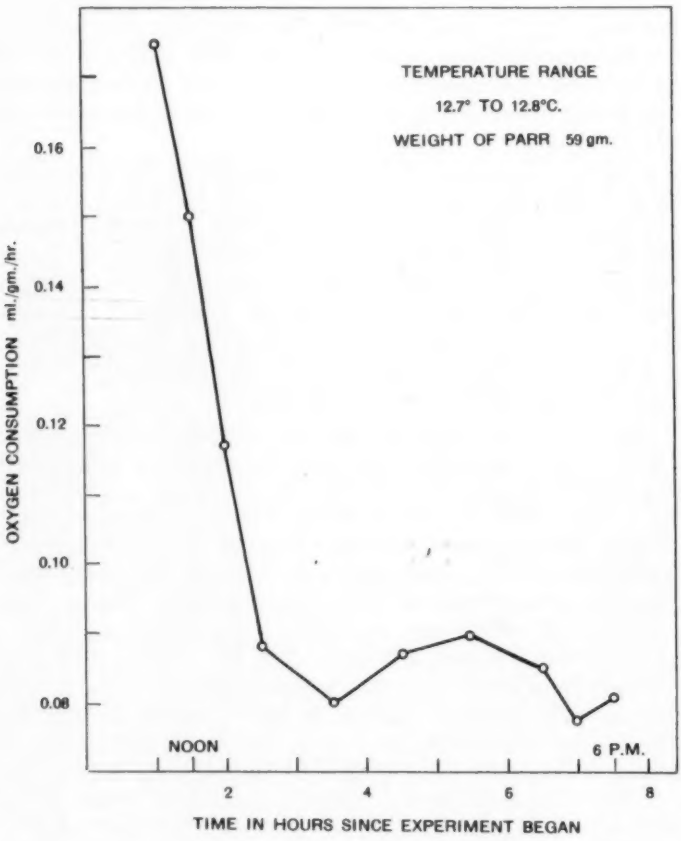

Fig. 2. The rate at which the oxygen consumption of salmon parr falls to the basal level after handling the fish.

Diurnal rhythm

Diurnal rhythms in the oxygen consumption of fish have been described by a number of workers, for example, Clausen (1936), Graham (1949), and Job (1954). Possibly related to these rhythms are variations in motor activity during a 24-hour period demonstrated by Spoor (1946) and variations in feeding activity shown by Hoar (1942). In measuring the basal metabolism of fish attention should be paid to the presence of any endogenous metabolic cycle and, ideally, basal oxygen consumption is measured when the cycle is at its minimum. In his work on the speckled trout Job (1954) found that the position of this minimum point varied, but in 60 per cent of his experiments it was in the night. In calculating the basal oxygen consumption he considered the lowest value obtained during a 24-hour experiment to be the basal value. For practical reasons it was not possible to adopt a comparable procedure in the field as experiments during the night were impracticable. In an attempt to find whether an endogenous cycle of oxygen consumption exists in salmon, experiments with three smolts were continued over a 26.5-hour period. The results are presented graphically in Fig. 3. The curves of oxygen consumption are smoothed by plotting in groups of three. The curves denoting temperature and oxygen content of the water are plotted directly. The most striking feature of the results is the similarity of the curves for the three fish. All show maximum oxygen consumption at midnight and midday and minima during early morning and late afternoon. Hoar (1942) found a somewhat similar cycle in the feeding activity of young salmon. They fed actively in the evening usually not ceasing until dark. Feeding recommenced at daybreak, increased in intensity during the morning, and was often followed by a slight cessation around midday.

General temperature response

The smolt data were analysed taking into account the differences between fish and the differences between rivers and it was found that a single slope adequately described the relationship between the logarithms of the oxygen consumption and the temperature. The results of other experiments on fish carried out under laboratory conditions (see Fry 1957) indicate that such a relationship could be expected over an environmental temperature range of 12°C. Although a significant difference in oxygen consumption between fish was found to exist, the F ratio being 19.3 with 18 and 97 degrees of freedom, no explanation for this is offered. It is apparently not correlated with weight, age or sex of the individual.

The regression equation describing the smolt data is

$$\log y = 0.06123x + \bar{2}.1087$$

where y = oxygen consumption in ml./gm./hr.

x = temperature °C.

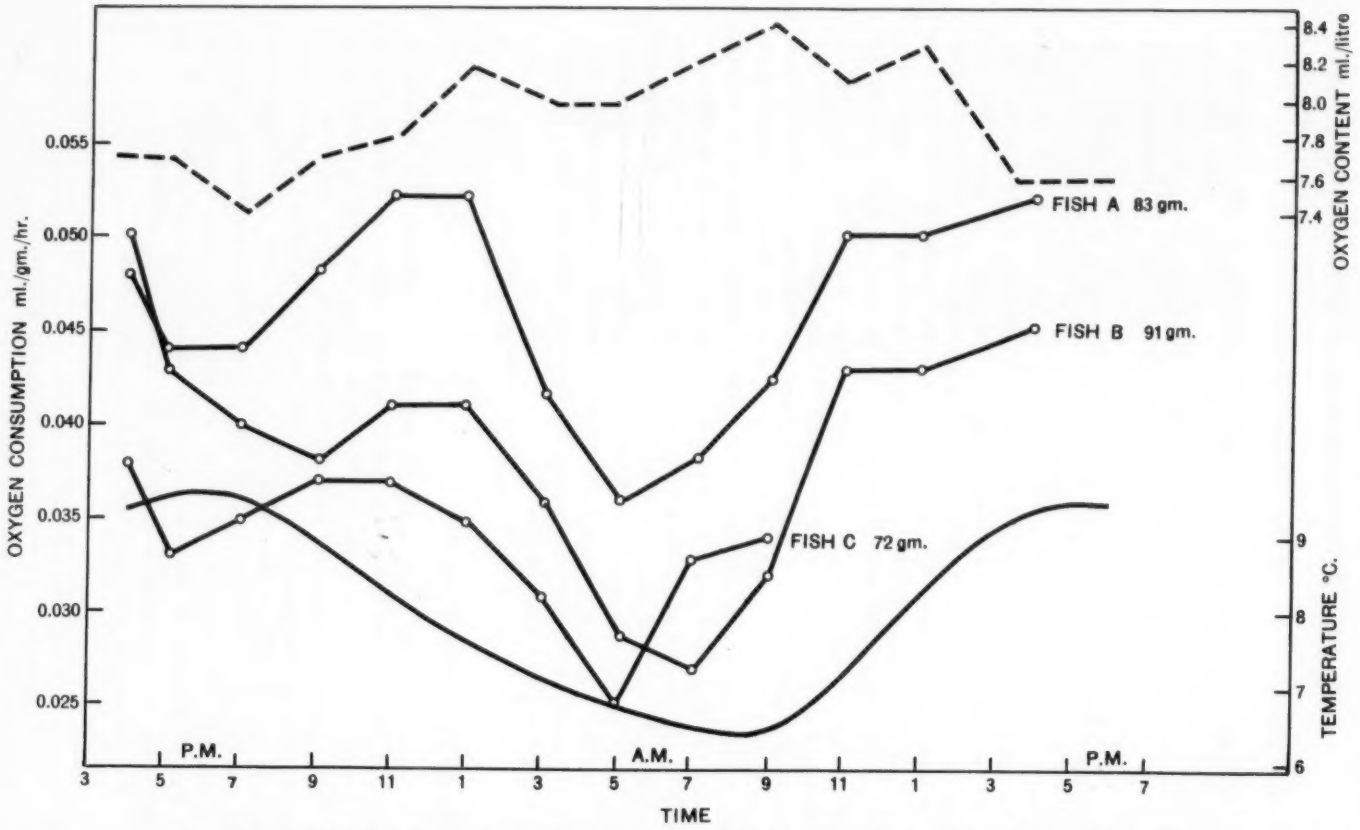

Fig. 3. The diurnal rhythm of oxygen consumption of three salmon smolts under natural environmental conditions.

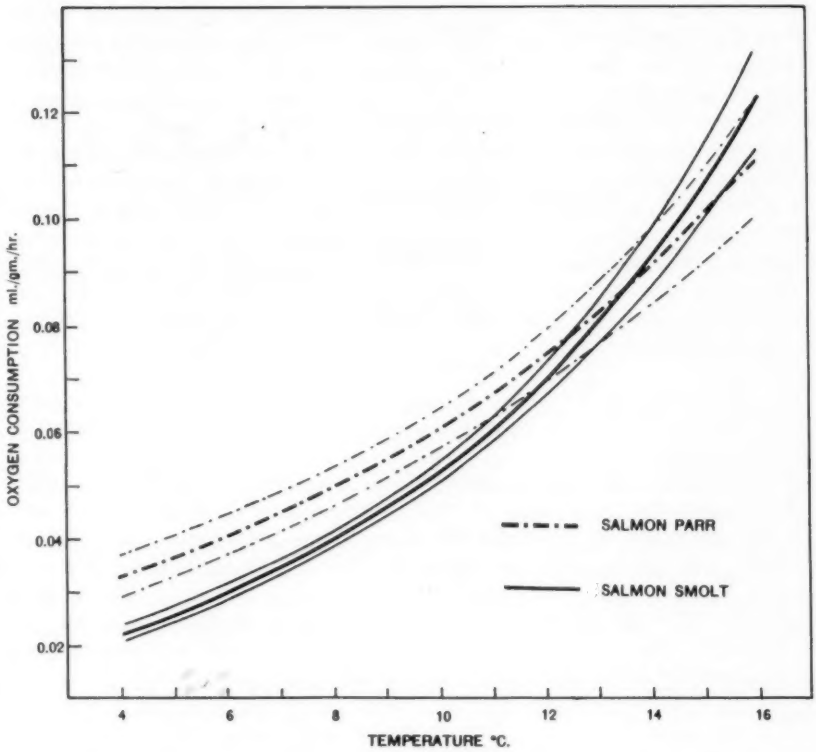

Fig. 4. The oxygen consumption of salmon parr and smolts from Ungava at temperatures between 4° and 16°C.

Fiducial limits to this line at the 95 per cent level of probability are given by

$$y^\circ = \tilde{y}^\circ \pm 1.98 \times 0.00784 \left[\frac{1}{137} + \frac{(x^\circ - 9.5044)^2}{1308.39}\right]$$

where $\tilde{y}^\circ$ is the calculated value of log y at a given temperature x°, and y° sets the limits for log y at that temperature.

The data obtained for the parr can be described by the regression equation

$$\log y = 0.04360x + \bar{2}.3497$$

and fiducial limits at the 95 per cent level of probability are given by

$$y^\circ = \tilde{y}^\circ \pm 2.0 \times 0.1215 \left[\frac{1}{68} + \frac{(x^\circ - 10.820)^2}{1022.12}\right]$$

In Fig. 4 the relationship between the oxygen consumption of salmon parr and smolts and the temperature is portrayed graphically and a number of

Fig. 3. The diurnal rhythm of oxygen consumption of three salmon smolts under natural environmental conditions.

deductions are made apparent. The oxygen consumption per unit weight of smolts is lower than that of parr below 13.5°C. but above that temperature it is higher. This is because the rate of increase of oxygen consumption with temperature is greater for smolts than for parr, (comparing regression coefficients $P < 0.001$) indicating that metabolically smolts are more responsive to temperature change. This may be of importance in the life of the salmon if temperature is one of the environmental factors important in initiating smolt migration. The physiological mechanism underlying this difference between smolts and parr may be related to changes in endocrine secretions that are associated with smolt development in salmon, notably increase in thyroid secretion. This is known to bring about an increase in metabolic rate in higher vertebrates although evidence from teleosts is conflicting (Hoar 1957).

Acknowledgements

The author wishes to express his gratitude to Dr. M. J. Dunbar under whose guidance this work was accomplished; to Dr. D. A. Sprott who carried out much of the statistical treatment of the data; and to Mr. W. Pollock who constructed the apparatus. Thanks are also tendered to the Arctic Institute of North America for Banting Fund grants received in 1956 and 1957 and for loan of field equipment; to McGill University for a Carnegie Arctic Research Scholarship during 1956-1957 and to the Department of Fisheries, Quebec, for a field grant in 1957.

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IN DEFENCE OF A STANDARD PHONEMIC SPELLING IN ROMAN LETTERS FOR THE CANADIAN ESKIMO LANGUAGE

Raymond C. Gagné

Introduction

In Canada several systems of writing the Eskimo language are in use at present. There is the syllabic system (small triangles, right and acute angles, semicircles, etc.), used by the great majority of the Eskimo people and several alphabetic systems based on roman letters. The syllabary, which consists of 48 symbols each representing a syllable, was introduced in the Eastern Arctic about 1885 by the Reverend E. J. Peck as a modified version of the syllabic characters in use among the Crees. Labrador Eskimo had already been recorded in roman letters as early as 1864 with the publication of Erdmann's Eskimo-German dictionary for use among the Moravian missionaries.

The syllabary, because of its relative simplicity, eventually spread to all parts of the Canadian Arctic with the exception of the Mackenzie River area and Labrador where only the alphabet is taught. It should be noted that the syllabary is also unknown in Greenland. Shortly after World War II some missionaries of the Eastern Arctic began teaching both the syllabic and alphabetic spellings to the Eskimo children in the hope of gradually introducing a more practical and accurate writing system, but the natives who know both systems are still a small minority. It is claimed that at least 75 per cent of the native population read and write syllabics. Of the 48 symbols of the syllabary, normally only 36 are used by the people east of Hudson Bay, whereas those west of the bay manage with 32. The differences in the alphabetic systems are much more varied, but in any event, none of these orthographies is common to all Eskimo. In spite of its many inadequacies, the syllabary is the system of writing that gained the widest currency and stands today as the most satisfactory medium of written communication for the majority of the Canadian Eskimo people. Though not completely accurate, as will be shown presently, the syllabary nevertheless leaves out of account the many non-essential phonetic intra- and inter-dialectal differences, which the various alphabetic systems reveal in abundance. This no doubt accounts in great part for its popularity.

On the other hand, what accounts for the shortcomings of the existing alphabetic orthographies and for their many points of divergence among themselves, is not so much the actual difference in the dialects on which

they are based, as the various personal interpretations made of the phonological structure by their inventors, who were mainly French, English and German missionaries, each of whom was strongly influenced by his own linguistic background. As a result, the existing wide variety of alphabetic spellings for Eskimo can be classified broadly as follows: spellings *à la française,* spellings *à l'anglaise,* and spellings *à l'allemande.* What is really needed is a spelling *à l'esquimaude,* that is, a system of writing based on a scientific analysis of the phonological structure of the Eskimo language in which all foreign linguistic influences must be left out of account. Modern linguistic research has shown the influence that languages in contact have on each other's phonological systems, for example, in such areas as Switzerland with its four official languages, and in bilingual Canada. An individual tends to interpret the sounds of a foreign language according to the sounds of his own. For example, unless taught the specific mode of articulation of the first vowel in the French word *lune* most English learners will pronounce it very much like the vowel of the English word *loon* because the French phoneme (basic functional sound) in question does not exist in English and the normal reaction of the uninitiated is to pronounce the foreign sound like the one it most closely resembles in his mother tongue. It should be noted that a German learning French has no difficulty with the first vowel of *lune* because that phoneme exists in German.

The present wide variety of Eskimo orthographies is a direct consequence of the subjective interpretation of their designers who, each in their own way, unknowingly and unintentionally vitiated the Eskimo phonemic reality. The growing contact between the Eskimo and the Whites in recent years makes efficient communication between them a matter of necessity. The adoption of a standard medium of written communication is of fundamental importance in achieving this goal, but above all, a standard spelling is imperative for the Eskimo people, not only to enable all their members to attain literacy in a common system of writing, but also to make it possible for them to share their thoughts and feelings with each other, either in the form of simple correspondence or in a literature yet to be born. To achieve these aims with the greatest degree of efficiency, a standard spelling must be introduced that will eventually replace the existing systems of writing that are all, in one way or another, inadequate. In what is to follow, it is my purpose to show why the only solution rests in presenting a new orthography in roman letters based on a scientific analysis of the phonemic structure of the Eskimo language.

A scientific orthography: its meaning and main purpose

The main purpose of an orthography is to be functional, namely, it should record as clearly, accurately, and economically as possible any and all the meaningful utterances permitted by the various permutations and combinations of the phonemes of the language in question. Writing, like other realms of human behaviour, has a long history of trial and error in

search of improvement or greater efficiency. Each attempt made in this field in the past was an effort to use visible symbols (pictures, signs, letters) to portray an invisible reality (the phonemes or combinations of phonemes) actualized in speech. Each designer of a writing system saw different significant units of the reality of language. For example, for the Chinese the idea or conceptual unit was the most meaningful item to symbolize, so they developed the ideogram or word-picture that describes a concept and not a sound. In this way a concept such as *man* might be pronounced differently in various dialects but its ideogram could easily serve for even the most radically divergent pronunciation of the word. Others became very conscious of the recurrent sound patterns or syllables in their speech, therefore they devised a syllabary in which each symbol stood for a syllable. Others went further and realized that even syllables could be broken down into smaller phonic constituents; consequently the alphabetic system of writing was invented. The most recent advance is phonemic writing, based on a scientific description of the sound structure of the language. Of course, the alphabetic orthographies designed in the pre-scientific era were in large part phonemic but usually imperfectly so. The majority of contemporary linguists agree that phonemic writing on a scientific basis leaves little margin for error, though André Martinet, the renowned French structuralist, who is of the same opinion, offers this word of caution: "even on the purely practical planes of language teaching, spelling reform, and the reduction of language to writing, the tyranny of the phoneme may also be detrimental . . . there are languages for which a syllabary would, if all factors were considered, appear to be more economical than an alphabet." (Martinet 1951).

Modern linguistic research has shown that each language possesses a phonological structure made up of a definite number of phonemes which are used in various permutations and combinations to express and to distinguish one meaningful unit from another. For example, *sing* and *ring* in English each contain three phonemes, /s/, /i/, /ng/ and /r/, /i/, /ng/ respectively, differing in meaning by virtue of the initial phoneme only. In *sing* and *sang* the second phonemes, and in *sin* and *sing* the final phonemes, establish a difference in meaning. If the phonemes of a given language can be combined in speech (words, phrases, sentences) and make their meaning intelligible to others, it should follow that when these same phonemes are represented graphically they should achieve the same result. Experience has shown that a clear, simple, and efficient orthography should contain no more graphic symbols than the number of phonemes in the language in question.

The chief defect of the Eskimo alphabetic systems is that they all contain more symbols (letters) than the actual number of Eskimo phonemes requires. The surplus letters symbolize non-functional phonetic differences that were considered functional by the non-natives who devised the spellings because they have a function in their mother tongues but they are not Eskimo phonemes. The most flagrant example of this is to be found in the use of the five vowels — *a, e, i, o, u* — in the French, English, and German versions

of the Eskimo vowels. Even though Eskimo has only three functional vocalic sounds — *i, a, u* — because the five vowels are phonemes in English, French, and German, it was easy for the missionaries to interpret the phonetic variants of the *i* and *u* Eskimo phonemes as two additional functional vowels, namely, *e* and *o*, for the simple reason that the latter have the function of distinguishing meanings in the European languages in question. It is a vitiation of the phonemic structure of Eskimo to impose upon it distinctions that are superfluous and unnecessary for distinguishing meaning. This kind of error is called the over-differentiation of phonemes.

On the other hand, the syllabary vitiates the phonemic structure of Eskimo by the under-differentiation of phonemes, that is, certain Eskimo phonemes that do not exist in the language of the non-natives are not heard as distinct functional units by them and therefore are left out of account when they speak and write Eskimo. A good example is the non-distinction of the /k/ and /q/ Eskimo phonemes in syllabic writing where both appear as /k-/. Only the context and the low functional yield of such a pair of phonemes can avoid the resulting ambiguity. For instance, if the /s/ and /r/ phonemes of English were both written with the same symbol, let us say /s/, upon reading the sentence *he sings the bell* common sense would tell us to interpret *sings* as *rings* in that particular context. It is easy to imagine utterances where the context would not be sufficient to clarify the ambiguity. Theoretically there would be nothing wrong in relying on context to differentiate meanings if it could be shown to be always dependable, for in reducing the number of symbols such a method would prove more economical. Such considerations are intimately related to the very important concept of functional yield. By functional yield is meant the frequency of occurrence of a given phoneme as being the only feature capable of distinguishing meaning between two utterances. For example, the /p/ and /b/ English phonemes have a fairly high functional yield as we can see in such pairs of words as *pill — bill, nipple — nibble, nap — nab,* etc. To assess properly the functional yield of a given phoneme in a language is a difficult and intricate matter, but it is worth while doing if it can serve the purpose of making an orthography simpler and more economical. For example, the final consonants in Eskimo have a low functional yield as evidenced by syllabic writing that functions satisfactorily even though it leaves them out of account. It would not be necessary to write them in an alphabetic system if it could be shown conclusively that context could always avoid ambiguity in the few cases where they have a function. If the syllabary proved adequate in spite of its under-differentiation of phonemes, it is because both the context and the low functional yield of certain phonemes came to its aid. It should be pointed out that the alphabetic systems are inadequate on account of both under- and over-differentiation of Eskimo phonemes, whereas the syllabary suffers only from under-differentiation. In the final analysis, the important thing to remember in designing an orthography is that it should never contain more symbols than phonemes found in the language in question.

The syllabary: its strength and weaknesses

It has already been pointed out that the syllabary, in spite of its inaccuracies, has proved to be the most satisfactory writing tool for the Canadian Eskimo people. There are two factors that speak in its favour as opposed to the present alphabetic spellings. In the first place, it eliminates the need to write the word-final consonants /p/, /t/, /k/ and /q/ whose functional yield is very low in many dialects. In some dialects the final consonants are still heard in many words but do not necessarily have a function in such positions. They show different degrees of wear or latency in the various dialects, both in regard to the total number of words thus affected and to individual words. For instance, though the final consonant of the word /illu(k/,q)/ "igloo" has been dropped in the speech of most people of the Eastern Arctic, this word is still sometimes heard as /illuk/ in the south of Baffin Island and as /illuq/ in Port Harrison. The syllabic writing gives *i-lu* (syllabic symbols are not reproduced here owing to printing difficulties) for both and thus avoids the problem of the different final consonants. However, what it gains in one position it loses in another, for it does not distinguish *igloo* and *frost* both written *i-lu* in syllabics. The roman spelling would distinguish these two words as follows: *illu* "igloo" and *ilu* "frost".

In the second place, the differences in alphabetic spelling of the various consonant clusters which appear interdialectally are avoided in syllabics. It eliminates almost 100 different consonant clusters found in the various Canadian Eskimo alphabetic spellings, for it has only single consonants at the beginning of a syllable. This tremendous simplification is very significant as it points to the minimal functional role, if any, of the post-syllabic consonant except where it is found as the first member of a geminate or double consonant and is needed to distinguish this from a single consonant as will be shown later. For example, *ippasaq* "yesterday" of Port Harrison, heard elsewhere as *ikpasaq* and *ikpaksaq*, can be written *i-pa-sa* in syllabics, thus easily overcoming the inter- and intra-dialectal differences. But here again, nothing prevents a roman spelling from achieving the same simplicity by writing this word *ippasa(q)* not to mention the added advantage of recording the double consonant which in many dialects must be distinguished from a single one in a similar phonetic environment.

Unquestionably, the syllabary is far closer to a phonemic orthography than either French or English spelling or any of the alphabets thus far devised for writing Eskimo. Nonetheless, the syllabary is inaccurate for reasons which will be made evident presently. In the final analysis, it must either be improved or discarded.

In a recent publication outlining the findings of a symposium of linguists and psychologists it is said: "The phoneme was foreshadowed by the pre-scientific invention of alphabetic writing. An adequate orthography of this kind disregards differences in sound which have no potential for the discrimination of meaning. Moreover, *unlike syllabic writing, alphabetic writing selects the minimal unit capable of such differential contrast.*"

(Osgood 1954, p. 10, italics mine). For instance, the Eskimo word *maniq* "lamp wick" in the Port Harrison dialect is distinguished from *manniq* "egg" only by virtue of the *n* at the end of the first syllable of the latter word. Since both are written *ma-ni* in syllabics they become homonyms graphically and thus are ambiguous. Except where the vowel alone forms the syllable, the syllabic symbols are all composed of two phonemes — a consonant followed by a vowel — therefore it is impossible to use these symbols for the post-syllabic consonant such as the *n* of the first syllable of *manniq*. One might rightly argue that such ambiguous pairs being so different in meaning might always avoid confusion in syllabic writing by never being found in the same context, and that, even if they were, a small post-syllabic symbol, prescribed by certain missionaries, standing for the single consonant or "the minimal unit capable of . . . differential contrast", could maintain the distinction. A brief glance at any publication which uses the secondary syllabic symbols will easily illustrate the complexity of such a practice, keeping in mind the minuteness of such symbols and the difficulty of reproducing them by hand at the upper right of the ordinary syllabic. They are very seldom used by the Eskimo people themselves. As mentioned earlier, this fact points to the low functional yield of the post-syllabic consonant and to the reliability of the context in avoiding possible ambiguities. These two factors plus the occasional paraphrase to avoid ambiguity have made it possible for the Eskimo to do without the secondary symbols which are difficult to manage in writing by hand.

Furthermore, the syllabary does not distinguish the following pairs of phonemes: /ng-/ and /g-/, /k-/ and /q-/, since both members of the first pair are written /g-/ and both of the second pair /k-/. The /g-/ and /r-/ phonemes are not distinguished by the Eskimo of the western Arctic, nor by all those of the eastern Arctic but the distinction exists in the syllabary. Many missionaries themselves have seen the defects and drawbacks of the syllabary and have recorded their views in print. The Reverend Maurice Flint gives the following opinion on the matter: "It should be fully stressed that the syllabic characters do not provide a scientific or perfect system for learning the Eskimo language, or reducing it to writing, but that they are an extremely simple form of shorthand representing phonetic spelling methods." (Flint 1954, p. vii). In addition, Father Thibert (1954, p. viii) makes these pertinent remarks in the introduction to his dictionary: "The syllabic system is a very simple way of writing syllables (not letters) with signs. Although it is very practical in many ways, it is not a precise manner of writing. Indeed, it is often ambiguous. For instance, *ka-ni,* (sounds representing the two syllabic symbols given by the author) may mean, KARNERK, hunger; KRANERK, mouth; KANNERK, snow; KRARNERK, burst; KRAMNERK, water flowing under the snow; etc. One must rely entirely on the context for the precise meaning of a word."

Aside from the few irregularities mentioned thus far, the syllabary follows the phonemic principle recommended by the majority of modern linguists as the soundest principle on which to base a system of writing.

This being so, why should it be considered necessary to introduce a new roman orthography instead of perfecting the quasi-universally accepted syllabic system, which is essentially phonemic? Could it not be easily revised and improved instead of being replaced?

The advantages of an alphabetic spelling

In my view, the only justification for a new standard spelling in roman letters is that it will be more practical and efficient and generally more beneficial to all concerned in the long run. If the official government policy had as its goal the complete assimilation of all Canadian Eskimo into the English or French culture of Canada as soon as possible, it would certainly be a waste of time and money to devise a new system of writing for this native population, because with a few improvements the existing syllabic spelling could serve the period of transition just as well, if not better. It seems, however, that the purpose of designing a common spelling is not only to ease communication among the various Eskimo dialectal groups, and between them and the white man, but also to foster a native literature through which this widespread native population can identify itself as a people possessing a distinct culture worthy of preserving. Thus, it becomes essential to make the new system of writing as practical and efficient as possible. As the title of this article indicates, it is my belief that this goal can best be achieved with a phonemic alphabet.

Experience in other parts of the world shows that the following principle enounced by the French linguist, A. Sauvageot, (1953, p. 64, my translation) should be given serious consideration: "the language of a small native population, in the general interest, must adopt the orthographic conventions of the language of civilization concurrently used by the people who speak it." Eskimo has come into contact with various languages of civilization, namely, Russian in north-eastern Siberia where it is written in the cyrillic alphabet, Danish in Greenland where its spelling is roman, and finally English, French, and German in Canada where the various alphabets devised bear the imprint of each of these European languages. The adoption of the syllabary would break one of the important bonds that exist between the Mackenzie River, Labrador and Greenlandic Eskimo dialects, namely, the roman alphabet. At the same time, the tie that links these dialects with the languages of civilization with which they are in close contact would be severed.

Through the process of history the roman alphabet has reached into most parts of the world and enjoys a position of prestige as a writing tool. There is the well-known example of Turkey, which adopted the Latin alphabet some thirty years ago when it wanted to strengthen its ties with the western world. Besides, there are probably more books in the world printed in roman letters than in any other writing system. Even if this were not so, the statement would certainly hold true for the North American continent, including Greenland, and the future of the Canadian Eskimo

people is obviously bound up with that of the North Americans and the Greenlanders. The fact that Greenland is already in possession of a considerable body of Eskimo literature in roman type is in itself reason enough for basing the new Canadian Eskimo orthography on the same alphabet. The literary achievement of the Greenlanders could serve as a source of inspiration to the Canadian Eskimo. A common system of writing would undoubtedly strengthen the cultural ties between these two groups of common ancestry. Of course, the mere fact of having a spelling system with a common basis would not necessarily ensure easy communication between a Canadian Eskimo and a Greenlander. There are linguistic differences as well, but they do not present insurmountable difficulties. Greenlandic spelling, like the spellings of the Canadian Arctic, is not flawless. One of its chief drawbacks is that it is heavily burdened with silent letters. At present some Greenlanders are considering slight spelling reforms that would bring their writing system much closer to the one being considered for Canadian Eskimo. In turn, every effort is being made to make the latter approximate the Greenlandic one as much as possible.

Already French and English have made their influence felt in the Eskimo world and this contact is increasing daily and will continue to increase even more rapidly, for there is no turning the clock back. Anthropologists and linguists alike have pointed to the dangers of too rapid a rate of acculturation of a small native population in the presence of a dominant culture. These dangers can be reduced if the major culture respects the cultural identity of the minor one. This can best be done by respecting the language of the minority, if as Hegel the German philosopher believed, language is the most important medium through which culture is expressed. It follows that a written language permits culture to be actualized in concrete and permanent form. Moreover, if this language can be written in a form that will serve both cultures in contact, so much the better. Since the practical means of preserving and spreading cultural unity and identity among the Eskimo are in the hands of the two dominant cultures in Canada, namely, the French and English ones, it would seem desirable for them to try minimizing the practical obstacles for both the native people and themselves. Though an orthography must serve primarily the native people for whom it is designed, there is no reason why it could not serve others as well. A standard roman spelling would encourage those who work closely with the Eskimo to learn their language and make this task easier. Even an inadequate knowledge of Eskimo among them would do much good.

The development of one writing system and its spreading into all corners of the Arctic could bring many advantages in the field of education as well. In this connection the advice of Sauvageot (1953, p. 55), based on the experience of various educational policies used with natives in different parts of the world, is worthy of note: "It is obvious that as long as we insist on teaching native children in French only, it will take a long time for us to achieve any measure of success with the majority of them . . . Experience

proves, in Madagascar as well as in Kenya or in Kamchatka, that the native who begins with his mother tongue subsequently makes more rapid and more solid progress in the foreign tongue taught him . . . The ground thus cleared is better prepared to receive another sowing . . . ." It might be added that some 30 years ago standardization of writing was introduced for the 1000 Siberian Eskimo, when the cyrillic alphabet was substituted for the roman. Soviet authorities claim that this change was one of the factors that brought rapid educational progress to their Eskimo. Today the Soviet Eskimo are being taught in their mother tongue by Eskimo teachers who have been trained in their own normal school. They are, like other members of the educated class, Eskimo-Russian bilinguals. In the final analysis the advantages of having a common alphabet for the native language and those of the dominant cultures in Canada are undeniable if Eskimo is intended to coexist with them.

Aside from the immediate and long-range benefits of a roman orthography, as just outlined, the main arguments against the widespread use of its alternative, the syllabary, are very practical. At a normal handwriting speed it is hard enough for the Eskimo to reproduce without danger of ambiguity the larger syllabics, such as the four vocalic signs consisting of a little triangle whose base appears at the top, the bottom, the left or the right, respectively, let alone the minute secondary signs, which might have to be used to make the syllabary more accurate. Quite frequently the *p*-plus-vowel series symbolized by a triangle without its base, pointing up, down, left or right, is not distinguished in rapid script from the *t*-plus-vowel series, which is a semicircle with the open side facing in the same directions. I have always been struck by the slow rate at which the natives read a new syllabic text. Sometimes non-natives were misled by this syllable-by-syllable type of reading to the point of coupling this inefficiency with the native's intelligence quotient. The difficulty of reading a new syllabic text can be compared to that which is met by one stenographer trying to decipher an unfamiliar shorthand text written by another. Furthermore, the absence of punctuation in unofficial texts, that is chiefly in correspondence, is another cause of slow reading and in some cases of ambiguity. Some Eskimo who know both the syllabic and alphabetic systems have expressed their preference for the latter on the ground that it is easier to read and write word units with letters than with the disconnected syllabic signs. The spaces between words are often not different in size from the spaces between syllables within a word. These may seem small matters but in reality, when added together, take on an importance that cannot be disregarded.

Many missionaries are at present using an alphabetic spelling as well as syllabics in their schools. From personal contact with these missionaries I have found them, with few exceptions, in favour of the idea of a standard alphabet although it was felt that the syllabary should not be replaced all at once. Both systems would probably have to coexist for at least one generation, during which time syllabics would gradually give way to the other. If done with care, the gradual replacement of one writing system by

another should be able to take place as painlessly to all concerned as the change from steam locomotives to diesel engines. Besides, Canadian Eskimo literature in syllabic script is not so voluminous — chiefly a small number of religious texts — that it could not be reprinted in the new orthography without incurring exorbitant expense. Furthermore, I do not believe that the Eskimo are sentimentally attached to their syllabics as many Englishmen and Frenchmen are to their spelling, and certainly they are not opposed to all spelling changes the way the white man is by reason of the etymological argument. However, it is interesting to note that today, after only 200 years of literary tradition, the Greenlanders are most reluctant to bring about any but the simplest spelling reforms. Aside from the deeply ingrained conservatism of people with long literary traditions, one of the most important objections to spelling reform in such languages as English and French, is a very practical one. The well-nigh insurmountable obstacle is the vast number of books which would no longer be of much practical value and the unimaginable costs of reprinting them in order to make them usable. These are reasons of a practical nature that cannot be easily ignored. But this is not the situation in Canadian Eskimo. In addition, the fact that standard type-setting machines and typewriters (although there are a few Eskimo syllabic typewriters in existence) could be used for Eskimo is by no means a negligible argument in support of the Latin script.

Conclusion

In the final analysis, whether it is the syllabary or a new standard alphabet that wins the present contest between them, neither can ignore the phonemic principle if accuracy, clarity, and simplicity are the desired goals. In a following paper, an attempt will be made to explain the phonemic principle that forms the basis of the proposed alphabetic spelling. The success of such a project depends to a very great extent on being able to show the validity of this principle to all those who may have a hand in shaping and implementing a new standard Canadian Eskimo spelling.

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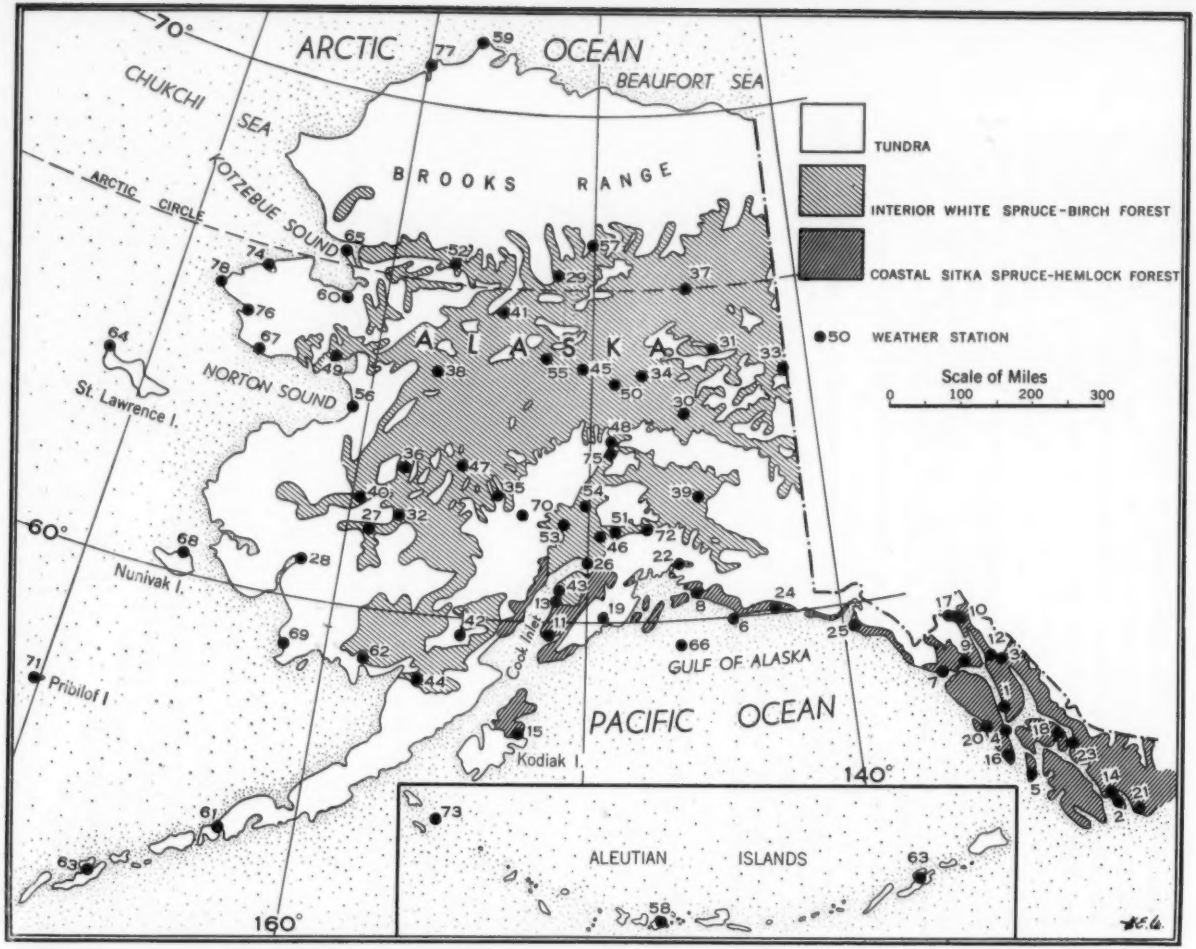

Fig. 1. Index map of Alaska

SOME CHARACTERISTICS OF THE CLIMATE IN FOREST AND TUNDRA REGIONS IN ALASKA*

David M. Hopkins†

THE present-day vegetation of Alaska consists of three major types: the coastal Sitka spruce-hemlock forest of southeastern and south-central Alaska; the interior white spruce-birch forest of central Alaska; and the treeless tundra of western and northern Alaska (Sigafoos 1958). All three vegetation types are represented by assemblages of fossil plant remains found in different strata of late Cenozoic age in western Alaska (Hopkins and Benninghoff 1953). A desire to assess the palaeoclimatic significance of these fossil plant assemblages led to the results that are presented here.

The coastal forest extends a few tens of miles inland along the coast of southeastern and southern Alaska westward to Cook Inlet and northeastern Kodiak Island (Fig. 1); the interior forest is distributed through most of central Alaska north of the coastal mountains and south of the Brooks Range; and the tundra is found beyond the continental limits of forest in central and western Alaska and in highland areas above the altitudinal limits of forest in central and southern Alaska.

Fig. 1. Index map of Alaska

Both forest types contain several species of trees in addition to those employed here to characterize them (Sigafoos 1958), and the tundra is a mosaic of many different sorts of vegetation, some of which are limited to either southern or northern tundra regions (Griggs 1936, Hanson 1953, Britton 1957).

The detailed boundary between forest and tundra is intricate and is determined by small differences in the character of the soil, drainage conditions, intensity of frost action, and perhaps microclimate (Sigafoos 1953). The detailed boundary between coastal and interior forest no doubt reflects similar minor variations in environmental conditions. In a few places in Alaska the boundaries between major vegetation units appear to be shifting actively and rapidly in response to recent small climatic changes (Griggs 1934). However, the data presented here suggest that in much of Alaska the gross boundaries between the three major vegetation types reflect regional or altitudinal differences in the annual temperature regime.

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† U. S. Geological Survey, Menlo Park, Calif.

It has long been recognized that the gross boundary between forest and tundra is related to some threshold value for summer warmth. Köppen (1936) and many others have pointed out a fair world-wide correspondence between the northern limit of trees and the 50°F. isotherm for the warmest month; Nordenskjöld's Arctic Limit (Nordenskjöld and Mecking 1928), which takes the mean temperature of the coldest month into account, coincides with the northern tree line about equally well; but both lines diverge grossly from the forest-tundra boundary in western Alaska (see Hare 1955, Fig. 21).

The relationships between cumulative summer warmth and the distributions of both individual species and larger vegetational units have been analyzed by many investigators concerned primarily with more temperate regions (cf. Merriam 1894, Livingston and Shreve 1921). Hare (1950) reviews the numerous studies that have indicated that mid-summer temperatures control the growth rates of the coniferous trees composing the boreal forest and shows that there is a close correspondence in northeastern Canada between zonal forest divisions and Thornthwaite's thermal efficiency index, an accumulating logarithmic function of monthly mean temperatures (Thornthwaite 1948).

This paper attempts to establish a more faithful correspondence between a temperature parameter and the forest-tundra boundary in Alaska using summations of cumulative summer warmth, and it attempts to characterize the differences between the temperature regimes of the region of the interior white spruce-white birch forest and the region of the coastal Sitka spruce-hemlock forest. The temperature records for 78 Alaskan weather stations that have been in operation for 10 years or more furnished the data for the study (Table 1).

After several other approaches had failed a good correspondence was discovered between the vegetation at the station and the number of degree-days above 50°F. on one hand and the mean temperature of the coldest month on the other (Fig. 2). Degree days are normally computed by calculating the sum of the departure of mean *daily* temperatures from an adopted reference temperature during a chosen interval. For this study the number of degree-days above 50°F. was approximated by multiplying the amount by which the mean temperature of the warmer *months* exceeded 50°F. times the number of days in the warm months. For example, a station reporting a mean July temperature of 55°F., a mean August temperature of 51°F. and mean temperatures below 50°F. for the other 10 months would be computed as follows:

$$5 \times 31 + 1 \times 31 = 186 \text{ degree-days above } 50°\text{F.}$$

All weather stations in either the coastal or the interior forest record more than 130 degree-days above 50°F., and nearly all weather stations beyond or above the limit of forest record less than 130 degree-days above 50°F. (Fig. 2). Similar but less sharply defined results were obtained by comparing the number of degree-days above 45°F. with the vegetation at the station, but no correspondence was found between the number of

degree-days above 40°F. or 32°F. and the local vegetation. The coastal Sitka spruce-hemlock forest and the interior white spruce-birch forest evidently have similar summer heat requirements; neither forest is found in areas having less than a critical amount of heat above a threshold value in the high 40's (°F.).

Several tundra stations in southern and southwestern Alaska report as much summer warmth as do stations in forested regions elsewhere. Treeless Middleton Island and Dutch Harbor (*66* and *63* on Figs. 1 and 2)

Table 1. Temperature data for 78 Alaskan weather stations that have been in operation 10 years or more (U. S. Weather Bureau 1947-1957)

Station	*Years of record*	*Degree-days above 50°F.*	*Temp. (°F.) of coldest month*
Coastal Sitka spruce-hemlock forest			
1. Angoon	33	302	29.3
2. Annette	15	581	34.6
3. Annex Creek	31	363	23.4
4. Baranof	15	476	29.2
5. Cape Decision	10	228	33.9
6. Cape St. Elias	15	431	33.1
7. Cape Spencer	19	161	32.2
8. Cordova WB	14	207	25.0
9. Gustavus	18	351	27.1
10. Haines CAA	29	590	23.2
11. Homer CAA	20	171	23.2
12. Juneau WB	15	384	26.2
13. Kasilof	14	279	13.4
14. Ketchikan	45	556	35.3
15. Kodiak	49	276	30.2
16. Little Pt. Walter	20	382	33.1
17. Moose Valley	10	528	10.0
18. Petersburg	24	470	28.6
19. Seward	34	401	24.2
20. Sitka Magnetic	72	488	33.3
21. Tree Point	18	656	34.8
22. Valdez	38	149	19.2
23. Wrangell	29	659	30.2
24. Yakataga	13	176	27.0
25. Yakutat	11	171	26.5
Interior white spruce-birch forest			
26. Anchorage	35	511	13.0
27. Aniak	13	328	-1.9
28. Bethel	34	301	6.8
29. Bettles	14	411	-12.5
30. Big Delta	14	613	-2.1
31. Circle Hot Sprs.	16	668	-13.1
32. Crooked Creek	11	485	0.4
33. Eagle	37	629	-12.4
34. Fairbanks WB	28	791	-9.8
35. Farewell	13	192	1.6
36. Flat	21	433	-2.0
37. Fort Yukon	30	776	-19.1
38. Galena	14	720	-9.3
39. Gulkana	15	406	-5.9
Interior white spruce-birch forest (cont.)			
40. Holy Cross	44	506	2.2
41. Hughes	13	577	-8.8
42. Iliamna	15	266	14.1
43. Kenai CAA	18	214	11.5
44. King Salmon	24	328	14.1
45. Manley Hot Sprs.	23	603	-10.1
46. Matanuska	33	563	13.1
47. McGrath	16	550	-8.7
48. McKinley Park	31	245	4.6
49. Moses Point	15	133	-0.5
50. Nenana	28	740	-8.0
51. Palmer 1N	15	513	13.4
52. Shungnak	10	396	-4.6
53. Skwentna	16	580	5.9
54. Talkeetna	36	497	8.5
55. Tanana	47	554	-9.5
56. Unalakleet	15	178	2.5
57. Wiseman	17	413	-9.9
Tundra			
58. Adak	14	40	32.8
59. Barrow	15	0	-17.9
60. Candle	21	90	-9.4
61. Cold Bay	13	65	28.4
62. Dillingham	16	340	15.9
63. Dutch Harbor	28	164	31.8
64. Gambell	17	0	3.4
65. Kotzebue	15	103	-21.0
66. Middleton Island	15	213	33.7
67. Nome WB	41	0	5.6
68. Nunivak	12	0	10.9
69. Platinum	13	93	14.6
70. Puntilla	10	65	3.4
71. St. Paul	38	0	23.8
72. Sheep Mountain	15	129	7.2
73. Shemya	10	0	30.9
74. Shishmaref	24	0	-4.3
75. Summit	15	74	2.3
76. Teller	15	31	-0.3
77. Wainwright	11	0	-17.9
78. Wales	13	0	0.8

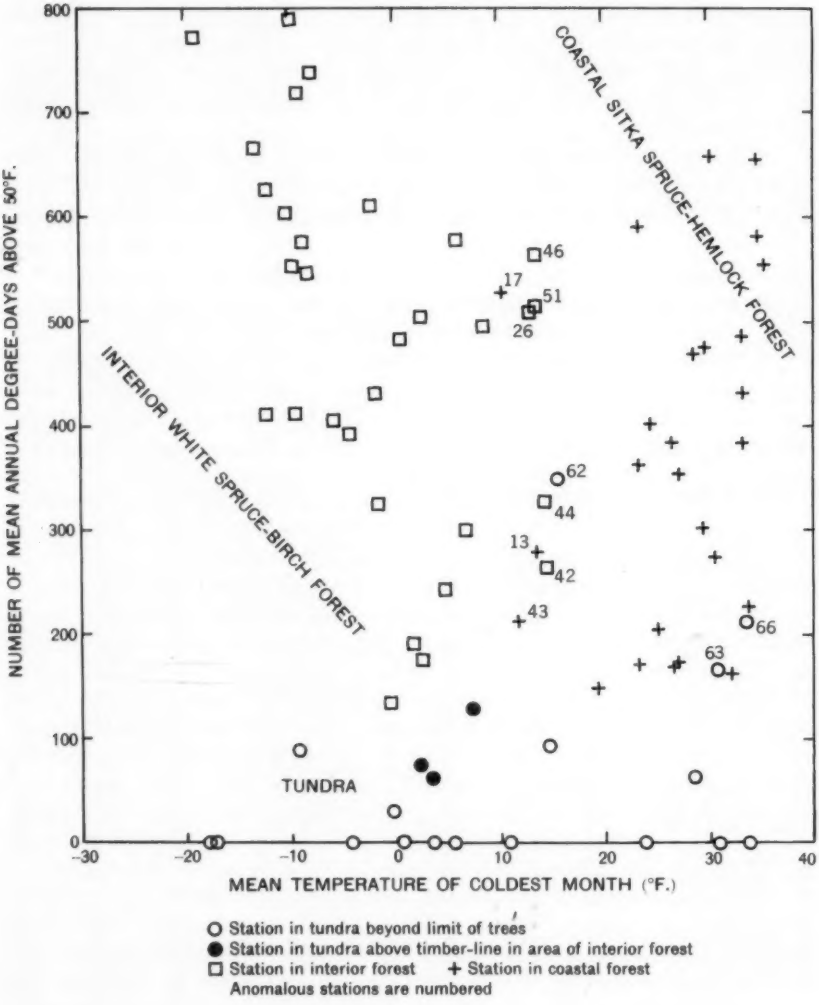

Fig. 2. Temperature conditions compared with vegetation at 77 Alaskan weather stations. Anomalous stations: *13*, Kasilof; *17*, Moose Valley; *26*, Anchorage; *42*, Iliamna; *43*, Kenai; *44*, King Salmon; *46*, Matanuska; *51*, Palmer; *62*, Dillingham; *63*, Dutch Harbour; *66*, Middleton Island.

Note added in proof: The symbol for Dutch Harbor, numbered *63*, has been misplaced and should be farther to the right to indicate that the temperature of the coldest month is 31.8°F.

are remote from sources of seed, but Sitka spruce has been successfully introduced on Unalaska Island near Dutch Harbor (Griggs 1936, p. 413). The other tundra stations having exceptionally warm summers (Dillingham — *62* on Figs. 1 and 2 — and several weather stations on Kodiak Island that were occupied too briefly to be included in this study) lie in a region in which both the coastal and the interior forest are reported to be vigorously expanding into the tundra (Griggs 1934).

The climates of the areas of the coastal forest and of the interior forest differ chiefly in the severity of the winters. Nearly all weather stations within the interior forest report at least one winter month during which the mean temperature is lower than 10° F., and nearly all stations in the coastal forest report no winter month having a mean temperature as low as 15°F. Tundra appears indifferently in areas having mild winters and in areas having cold winters.

Three stations in the coastal forest near the boundary with the interior forest (Kasilof, *13;* Kenai, *43;* and Moose Valley, *17,* on Figs. 1 and 2) and five stations in the southern part of the interior forest (Matanuska, *46;* Palmer, *51,* Anchorage, *26,* King Salmon, *44;* and Iliamna, *42*) report coldest winter months having temperatures between 10°F. and 15°F. The stations clustered about the head of Cook Inlet lie in a transitional zone in which the two forest types intergrade; along the line on the map separating the two types, the forest is a mixture of Sitka spruce, white spruce, and hybrids between Sitka and white spruce (Sigafoos 1958, p. 177; Benninghoff, written communication 1958). The other three stations lie in areas where the interior and coastal forests are isolated from one another by mountain ranges bearing only tundra vegetation, so that opportunities for mixing and hybridization are at a minimum.

Assemblages of fossil plants furnish part of the evidence on which palaeoclimatic interpretations must rely. Attempts to reconstruct ancient climates using the evidence of fossil plants rest on the assumption that the ancient forms had nearly the same ecological requirements as their living representatives. The reliability of the assumption improves with increasing size of the fossil flora, with increasingly close taxonomic relationship between the individual fossil forms and their living representatives, and with decreasing time separation between the age of the fossil flora and its living equivalent. Unfortunately, fossil plant assemblages generally represent only a small part of the plant community from which they were derived, and commonly the identity of the individual forms with living forms cannot be proved; but this difficulty is minimized for many fossil floras by the availability of collateral pedologic, stratigraphic, or geomorphic evidence concerning the nature of the climate in which the floras lived.

It is reasonable to assume that the assemblages of species making up the major vegetation types in Alaska have had approximately the same climatic requirements during much of late Cenozoic time, and that fossil assemblages clearly assignable to these major vegetation types may be

used as evidence in palaeoclimatic reconstructions. Fossil remains of coastal Sitka spruce-hemlock forest suggest past periods of warm summers and mild winters; fossil remains of interior white spruce-birch forest suggest past periods of warm summers and severe winters; and fossil remains of tundra vegetation suggest past periods of cold summers and either mild or severe winters.

I have benefited greatly by discussing the ideas presented here with R. S. Sigafoos and W. S. Benninghoff.

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ROALD AMUNDSEN*

Harald U. Sverdrup

ROALD Engebregt Gravning Amundsen (1872-1928) was the first to navigate the Northwest Passage, the first to reach the South Pole, a navigator of the Northeast Passage, the first to fly to latitude 88°N. and the first to fly across the Arctic Ocean.

Early life

Amundsen was born on July 16, 1872 on a small farm near the town of Sarpsborg in southeastern Norway. For five generations his ancestors had been farmers and sailors. Roald Amundsen's father, Jens Amundsen, sought the sea and worked his way up until he captained his own ship. With his two brothers and a brother-in-law he developed a flourishing shipping business, which operated up to 22 sailing vessels.

When Roald was only a few months old his father moved to Oslo (then Christiania) where he bought a property on the outskirts of the city. Here Roald and his three older brothers grew up, taking full advantage of the facilities for skiing and skating and spending their summers sailing and fishing. Their father was a powerful man of the stern old school, who claimed full authority in his home and gave his boys some sound advice: "I had never a chance to get an education and have often felt my handicap. It is not enough to have the will to work, one must also have knowledge. I want you boys to learn more than I did." And: "I don't want you to get into any fights, but if you have to fight, deal the first blow and see to it that one blow is enough."

Roald may have followed the latter advice, but not the former. He did manage to get admitted to the university when he was eighteen, but he was at the bottom of his class. He was a quiet boy who evidently considered the school a necessary evil and who from the age of fifteen had made up his mind about his future. He wanted to explore the polar regions and his first goal was the navigation of the Northwest Passage.

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He had come across the accounts of the Franklin Expedition and had read every book he could find about the search parties that for 20 years tried to learn the fate of Sir John Franklin and his men. The search had led to the discovery of the Northwest Passage, but no navigator had yet succeeded in sailing a ship through the ice-filled and treacherous waters. Here was a task that appealed to Roald's imagination, a task surpassing Nansen's crossing of Greenland, which had set him afire. Neglecting his homework he read and re-read the great travel books from the Arctic.

He wanted to prepare himself thoroughly for his career and would have preferred to go to sea in order to obtain his master's papers, because he wanted to be captain on board of his own ship. However, his older brothers were already sailors, and his mother, now a widow, wanted her youngest son to stay away from the sea and study medicine.

Amundsen felt it his duty to follow his mother's wishes, but he spent little time studying and much more in hardening himself and developing a magnificent physique. When his mother died in 1893, Amundsen sold his few medical books and got a berth as ordinary seaman on board the sealer *Magdalena,* the ship which later, renamed *Danmark,* was used by Mylius-Erichsen on his East Greenland expedition of 1906-8. During the following years Amundsen advanced steadily, in 1895 he obtained his papers as mate and in 1900 his master's license. In later years the only title he liked to have applied to him was that of "Captain".

He gained his first experience in the polar regions from 1897 to 99 when he took part in de Gerlache's antarctic expedition as mate of the *Belgica* and spent a year drifting with the ice between longitudes 70° and 100°W. The western part of that region is now called Amundsen Sea. Dr. Frederick A. Cook was physician on board of the *Belgica.* Amundsen admired Cook's ability and initiative, and the friendship that grew up between the two men lasted through their lives in spite of the different fates of the two.

The Northwest Passage

After his return from the *Belgica* expedition Amundsen considered himself experienced enough to start preparations for realizing his boyhood dream, but first he had to get the support of his hero, Fridtjof Nansen. Nansen not only approved the plans, but in years to come gave advice freely whenever Amundsen asked for it and repeatedly helped to straighten out Amundsen's tangled finances.

Nansen's eminent scientific ability and his enthusiasm for expanding scientific knowledge of the Arctic must have exercised a considerable influence on Amundsen's thinking and must have strengthened his wish to get acquainted with different methods of observation so that he, though no scientist himself, could collect accurate data for others to analyze.

One important problem presented itself, the relocation of the north magnetic pole, which had been visited first in June 1831 by James Clark Ross. In order to make himself familiar with magnetic measurements,

Amundsen went to Hamburg where he presented his plans to Dr. G. von Neumayer, at that time the foremost expert in the field of terrestrial magnetism, and asked advice regarding instruments and methods of observation. Neumayer received Amundsen most cordially, encouraged him and instructed him for several months in all the details of precise observations.

The next step was the search for a suitable ship. It had to be small, sturdy, and inexpensive because he hoped to finance the expedition himself and he had only a small inheritance at his disposal. After thorough examination Amundsen bought the small sloop *Gjøa* of only 46 tons, which had been built in 1872, the year Amundsen himself was born, and which was still as sound as he. In the next summer, 1901, he took the *Gjøa* for a cruise to the East Greenland waters, partly to get acquainted with the handling of the ship and partly to undertake oceanographic observations in which Nansen was particularly interested.

The following two years were spent in carefully selecting and testing equipment and provisions and in assembling the small party that could be accommodated on board the ship. It soon became clear that Amundsen's own funds were quite insufficient to cover all expenses and much against his wishes he had to ask for support from various sources. He did this reluctantly because he hated to talk about plans and preferred to keep away from all publicity until he had reached his goal. He retained this characteristic through life, but in later years he became too much of a public figure to stay out of the limelight. There is, however, no doubt that his reluctance to discuss plans, which was often considered a special form of conceit, had deep roots and that by nature he was a lonely man who preferred action to words.

The financial support that Amundsen was able to obtain for his first expedition was still inadequate, and when he was ready to sail in June 1903 he found himself considerably in debt. He himself tells that, when one of his creditors threatened to place the *Gjøa* under lien until payment was made, he decided to sneak away after having informed the crew of his plans. According to another source Nansen himself undertook the responsibility for the departure by promising Amundsen to see to it that his creditors were satisfied. Be that as it may, the *Gjøa* left Oslo about midnight on June 16, 1903, and the creditors were paid when the Northwest Passage had been conquered.

After having studied all available accounts of earlier expeditions, Amundsen had decided to try the straits between the American mainland and the southern islands of the Canadian Archipelago. The *Gjøa* first called at Godhavn, Greenland, to take 20 dogs on board and next at Dalrymple Rock to obtain supplementary provisions and kerosene from Scottish whalers. From there Amundsen continued past Beechey Island and then turned south into Peel Sound and Franklin Strait.

Storm, fire in the engine room, and near shipwreck on a submerged rock threatened to bring the journey to an early end, but superb seamanship and quick action prevented disaster on each occasion.

It seems possible that the *Gjøa* could have sailed through the Northwest Passage in one season, because Simpson Strait was free from ice when the eastern entrance was reached on September 9. However, the navigation of the Northwest Passage was only part of the program, the relocation of the north magnetic pole and continuous recordings of the magnetic elements during at least one full year were equally important. Since the recordings should preferably be made at a distance of about 100 miles from the magnetic pole, Amundsen was on the lookout for a suitable wintering place when approaching King William Island and was delighted at the discovery of the nearly closed and completely sheltered little bay that now on all charts carries the name Gjoa Haven. After a careful survey of the bay the *Gjøa* sailed into it, anchored, and stayed there for two years.

Besides Amundsen the party consisted of the following six men: Godfred Hansen, lieutenant in the Danish Navy, second in command, navigator, geologist, and astronomer; Anton Lund, first mate, with much experience in ice navigation; Peder Ristvedt, meteorologist and engineer; Helmer Hansen, second mate and also an experienced sealer; Gustav Juel Wiik, magnetic observer who with Amundsen would be responsible for the magnetic observations; and Adolf Henrik Lindstrøm, the "polar cook", who had been cook on the Second Expedition in the Fram from 1898 to 1902 and now served in the same capacity in the *Gjøa*.

It was not economy alone that was responsible for Amundsen's selection of a small ship, which could not accommodate a large party. The choice of vessel was also based on the one principal thesis to which Amundsen subscribed on this and every other of his subsequent expeditions: a party should be the smallest possible consistent with the purpose of the enterprise. Only by adhering to this rule would it be possible to keep each man fully employed and to make him feel that his personal effort was all-important to the success of the expedition. Amundsen considered it his duty as leader to see that none of his men had an opportunity to loaf or become demoralized because he felt that he was wasting his time on useless assignments. On the *Gjøa* expedition Amundsen had little difficulty in discharging the duties of leader because the party was so small and was composed in such a manner that each man had to be given more than one task for which he must be responsible.

Wiik and Ristvedt built their magnetic observatory on shore and added a shack where they lived for nearly two years, collecting a wealth of data that was taken over by the Norwegian Government and later distributed to specialists for working up and publication. The continuous meteorological observations at *Gjøa* Harbour added much to the knowledge of the climatology of that part of the Arctic. After two shorter trips in March 1904 to establish caches Amundsen and Ristvedt started on April 6 on a sled journey to Boothia Peninsula in order to take observations close to the magnetic pole. A series of stations was occupied and the observations showed that the pole was located in 1904 near the place at which James Clark Ross had first found it 73 years earlier.

From April 2 to June 23, 1905 Godfred Hansen, also accompanied by Ristvedt, explored the east coast of Victoria Island between latitudes 70° and 72°N. and mapped this previously unknown coast line.

There were no Eskimo at Gjoa Haven when winter quarters were established, but in November the first arrived and from then on the contact was permanent and evidently mutually beneficial. Amundsen and his party obtained prepared reindeer skins as well as complete outfits of clothing and learned how to build snowhouses. On subsequent expeditions Amundsen used Eskimo-type clothing and footgear with some minor modifications, but neither he nor any of his companions became such experts in building snowhouses that they could discard their tents. The Eskimo, on the other hand, received needles, knives, empty tin cans, and many other useful articles from the visitors. All the different groups that visited the *Gjøa* had had very little contact with western civilization; they were practically lacking iron and steel and had little knowledge of firearms. Amundsen made extensive notes of their customs and brought back a large collection of their various implements. Amundsen's views on cold-weather clothing are stated or implied in a number of his writings. The essence is found in the chapter "Towards the Magnetic Pole", which is the fifth chapter of Volume I of the English edition of "The Northwest Passage".

"We were ready to leave on the first of March. The thermometer showed -55°C. (-63°F.). But through the month of February we had become so accustomed to the cold that it did not bother us much. We were also very well dressed. Some of us wore complete Eskimo costumes, others partly civilized clothing. My experience is that in these parts in winter the Eskimo dress is far superior to our European clothes. But one must either use it alone or not at all. Any combination is bad. Wool underwear gathers all perspiration and will soon make the outside clothing wet. Dressed entirely in reindeer skin, like the Eskimo, and with the clothing loose enough on the body to let the air circulate between the layers, one will as a rule keep the clothing dry. If one is working so hard that the clothing becomes damp in spite of everything, skin dries much easier than wool. Also wool clothing becomes dirty easily and loses its warmth. Skin clothing keeps nearly as well without washing. A further great advantage of skin is that you feel warm the moment you put it on. In woolen things you have to jump and dance like crazy before you get warm. Finally, skins are absolutely wind-proof, which is of course a very important point."

In the summer of 1905 the *Gjøa* was made ready for continuing her journey and if possible completing the Northwest Passage. On August 13 she left the now ice-free Gjoa Haven and set her course toward the unknown west. Ice, fog, and shoals endangered the progress, the sounding lead had to be used continually and often there was hardly a foot of water under her keel. However, the *Gjøa* advanced and on August 17 she dropped anchor at Cape Colbourne, the easternmost point that had been reached in these waters by any ship coming from Bering Strait. The Northwest Passage was completed. A few days later, on August 26, the first ship was

sighted, the *Charles Hansson* of San Francisco, commanded by Captain J. McKenna, who was the first to congratulate Amundsen on his success.

Amundsen, of course, hoped to reach Bering Strait and civilization that year, but ice conditions were bad. As early as September 2 progress was stopped at King Point, near Herschel Island, and within a week it was evident that another winter had to be spent in the Arctic. This time the *Gjøa* had much company because no fewer than 12 ships had been caught at Herschel Island.

The magnetic recordings were continued at King Point, and during the winter Amundsen travelled to Eagle, Alaska, in order to send telegrams from the expedition to the outside world. He made the trip in company with the skipper of the shipwrecked *Bonanza,* Captain Mogg, of whose accomplishments as a traveller by dog team Amundsen had a very low opinion. On his return to King Point Amundsen learned the sad news that Wiik had been taken ill and died.

By the middle of August 1906 the *Gjøa* could resume her journey. She reached Nome on the 31st, where she was given a reception worthy of the adventurous and boisterous gold seekers who at that time were making Nome famous. From there on the trip back to Norway was a triumphant journey that brought Amundsen full compensation for his worries and difficulties during the trying years of preparation. The *Gjøa* was however not returned to Norway. She was presented to the city of San Francisco and was in 1909 placed in Golden Gate Park. She deteriorated badly, but was restored in 1948.

Plans for crossing the Arctic Ocean

For two years following the return of the *Gjøa* Amundsen was engaged in writing and lecturing in order to improve his shaky finances. He hated the lecture trips on which he had to place himself in the hands of a manager and sell his freedom of action to a person whose publicity schemes he disliked but could not avoid. Little wonder then that he soon worked on a new plan, which he presented to the Norwegian Geographic Society in the fall of 1908. He proposed to use Nansen's ship, the *Fram* and repeat Nansen's famous drift across the Arctic Ocean. The main purpose would be the repetition of the oceanographic work of Nansen, using better equipment and new and greatly improved instruments. Nansen had not been prepared for the great depths he discovered and was not equipped with adequate sounding lines and the deep-sea oceanographic work was consequently much handicapped. Furthermore, the available deep-sea thermometers and other instruments were inaccurate. By ingenious interpretation of the imperfect observations Nansen had been able to recognize the main features of the oceanography of the Arctic Ocean, but in spite of his brilliant analysis several points remained in doubt on account of the deficient data. In the years since the return of the first *Fram* expedition Nansen himself had contributed much to the improvement of

instruments and methods. By using the new technique Amundsen hoped to expand and confirm Nasen's results. Nansen was much interested in Amundsen's new plans and gave them his wholehearted support. Private and public funds were obtained and the outlook for the expedition was bright. A great deal of the public interest in the expedition was based on the assumption that Amundsen would make a dash for the North Pole and it was confidently expected that he would succeed and become the first man to reach that coveted spot. There is no doubt that Amundsen wanted to have a try at reaching the Pole, although he never said so directly.

That the public was more interested in the spectacular aspects of the expedition than in its laborious scientific work became evident when support failed in the early summer of 1909 after it was learned that both Frederick A. Cook and Robert E. Peary claimed to have reached the North Pole.

The South Pole

These events led to a complete change in Amundsen's plans for his contemplated drift across the Arctic Ocean. The public interest in his expedition dropped off, the contributions ceased, and it appeared hopeless to equip the *Fram* for 5 years. He also felt that to maintain his name as explorer he had to accomplish a sensational feat. Without informing more than three of his closest associates he decided to try to reach the South Pole. When the Fram left Norway in June 1910 the official plan was that she should sail around Cape Horn, continue north through the Pacific and enter the Arctic Ocean through Bering Strait in the summer of 1911, but from Funchal, Madeira, Amundsen announced that he was instead heading for the Bay of Whales in the Ross Sea and from there was trying to reach the South Pole.

Amundsen's message reached Captain Robert Scott as he was ready to leave New Zealand to establish a base in McMurdo Sound, about 350 miles to the west of the Bay of Whales, from where he intended to reach the South Pole. Severe criticism was directed against Amundsen on the basis that he had entered a race against Scott, but it has gradually been admitted that Amundsen could not be blamed for attempting to reach the South Pole by a route different from that selected by Scott and using a different technique. Amundsen and four companions reached the Pole on December 14, 1911, Scott on January 18, 1912, but Scott and his brave comrades perished on the return journey.

The Northeast Passage

As soon as Amundsen was back in civilization he resumed his plans for the drift expedition across the Arctic Ocean. The *Fram* had taken him and his party on board in 1912 and gone to Hobart, Tasmania, from where Amundsen sent his first brief report. From Hobart the ship had continued to Buenos Aires for overhaul. After supplementing her equipment she was

to return to the Pacific and sail north to Bering Strait. In 1913 when Amundsen was lecturing in the United States it was suggested to him that the *Fram* might be permitted to go as the first ship through the Panama Canal. Amundsen was anxious to take advantage of this opportunity and ordered the *Fram* to Colon. However, after having waited in vain for two and a half months she had to be sent back to Buenos Aires with orders to go around Cape Horn and on to San Francisco. The bottom of the ship had become so badly fouled that the trip to Buenos Aires took too long to make it possible for the *Fram* to reach San Francisco in time to continue to Bering Strait in the summer of 1914. Amundsen decided to have the *Fram* return to Norway and start from there in 1915 by following the north coast of Siberia to the east as Nansen had done in 1893. The *Fram* arrived in Norway only two weeks before the outbreak of World War I, which temporarily stopped Amundsen's plans. They were still more seriously upset when it was found that the *Fram* had been damaged beyond repair by dry rot during the long stay in the tropics.

At this point it should be mentioned that Amundsen had long contemplated the use of airplanes in arctic exploration, thus pioneering a development that was to revolutionize arctic work. As early as 1909 when he was making his first preparations for the drift expedition he had negotiated with one of the early aviators about participation in the enterprise, and in 1914 he had bought a Farman biplane in the United States and shipped it to Norway where he himself obtained a certificate as pilot and where he gave it to the Norwegian Government at the outbreak of the war.

The war and the loss of the *Fram* did not make Amundsen abandon his plans. He invested his accumulated funds in shipping stock, doubled his capital and contracted in 1916 for the building of a new ship, which still left him enough money to finance the long-postponed drift expedition. His new ship was launched in June 1917 and named the *Maud* after the Queen of Norway. The *Maud* had been designed by the yacht builder Chr. Jensen and was built along lines similar to those of the *Fram*, but she was even more bowl-shaped. Her over-all length was 120 feet, her beam 40 feet and in any vertical section, lengthwise or athwart ship, the line of the hull was part of a circle. From the outer side of the ironwood ice-sheathing to the inner side of the inner sheathing the sides were nearly three feet thick. Inside the hull was strengthened with vertical and inclined stanchions that were tied with naturally-grown knees of oak. Her shape made her behave excellently under heavy pressure from ice, but in the open sea she rolled like a wash basin.

During the winter 1917-8 Amundsen equipped the *Maud* for a five-year journey, obtaining provisions from the United States under special license. On July 18, 1918 the expedition sailed from Vardö, Norway with a party or nine. This number was increased to ten when a Russian-Norwegian engineer was added at Kharborovo. The party included Helmer Hansen as captain, who had been with Amundsen through the Northwest Passage;

Oscar Wisting, first mate, who had been to the South Pole; and among the three tenderfeet was Dr. H. U. Sverdrup, in charge of scientific work.

The *Maud* expedition met with many difficulties. In September 1918 progress was stopped some 10 miles to the east of Cape Chelyuskin, where the *Maud* stayed a full year. That period was used for carrying out scientific observations and charting the northernmost peninsula of the continent.

In the summer of 1919 the ice did not break up around the *Maud* and only on September 12, after much blasting and advancing foot by foot did the ship reach open water and could continue to the east. Here two men, Knudsen and Tessen, were left behind. They had volunteered to return to Port Dickson with the records of the year's work. They had a number of dogs and provisions for a year and had the choice of leaving in the fall or waiting until the following spring. They left in the fall but failed to reach their destination.

The *Maud* sailed to the east but the season was too late to penetrate to the north and start the drift. An attempt to turn away from the coast east of the New Siberian Islands failed and on September 21 all progress was stopped. Winter quarters were established on the open coast of Ayon Island about 600 miles west of Bering Strait. During the winter Sverdrup left the ship and stayed for eight months among the Reindeer Chukchi.

In July 1920 the journey east was resumed and on July 28 the *Maud* reached Nome. Amundsen thus completed the Northeast Passage that had been navigated for the first time by A. E. Nordenskiöld in the *Vega* from 1878 to 79 and for the second time in 1914-15 by the two Russian icebreakers *Taimyr* and *Vaigach*, the latter sailing from east to west.

In Nome Amundsen announced that all his companions were free to leave the expedition, which had already been in the Arctic for two years without having started its actual task, the drift. Four of the eight remaining in the party decided to return to Norway. Since no new men could be found in Nome, the *Maud* left with only four men on board, including Amundsen. His plan was to return to the Siberian coast, take some natives on board and attempt to start the drift. However, the ice conditions were worse than before and after a long struggle in which the propeller shaft was damaged, it became necessary to go into winter quarters only 25 miles from the place where the *Vega* stayed in 1878-9.

During the winter Amundsen decided that next year he would leave it to Wisting and Sverdrup to have another try at the drift if they were willing and that he himself would return to his old plans for the use of airplanes in the Arctic. Consequently the *Maud* was taken to Seattle in the summer of 1921 for repairs. She left again for the Arctic in June 1922 with a crew of eight, including a native boy from Siberia and finally succeeded in getting away from the coast. She became fast in the ice east of Wrangell Island but was not carried across the Arctic Ocean as had been hoped. After two years she got out of the ice north of the New Siberian Islands and tried, according to Amundsen's directions, to return to Bering Strait, but she had to spend one more winter on the Siberian coast near

the Bear Islands off the mouth of the Kolyma River. The *Maud* and her crew finally returned to Seattle in October 1925 with a wealth of observations that made the expedition a scientific success.

Difficulties

During the years from 1922 to 25 Amundsen experienced the bitterest disappointments, but also the most spectacular triumph of his varied life. In 1922 he had bought a Junkers plane, which the *Maud* took to Point Hope, Alaska, where it was transferred to the *Holmes,* which unloaded it at Wainwright. Amundsen with Oscar Omdal as pilot hoped to fly from Wainwright to Spitsbergen in the spring of 1923, but when spring came it was impossible to get the plane off the ground with the necessary supply of fuel and the plan had to be given up.

After returning to Norway in 1923 Amundsen found himself at the lowest ebb in his career. He had hoped to raise funds for an airplane expedition to start from Spitsbergen, but he found himself blocked in every direction. From the public point of view the *Maud* Expedition was a failure and furthermore it was considered that Amundsen should have stayed with the ship instead of trying ventures, which were called stunts that were unworthy of being taken seriously. All sorts of rumours were being circulated reflecting not only upon Amundsen's intentions as serious-minded explorer, but also upon his morals. On top of all that Amundsen found his finances in a hopeless tangle. On previous occasions he had often been close to bankruptcy, partly because he was so engrossed in his undertakings that he always was convinced that somehow the funds would be forthcoming. So far his optimistic calculations had been successful because help had always arrived when it was most needed, but in 1923 no help was in sight. His debt had increased steadily, partly because some of his trusted friends had been far too optimistic in their dispositions. His only asset, the *Maud,* was drifting in the ice north of Siberia and nobody knew if she ever would return. The most distressing blow came from his own brother who had lent him money and now feared that everything would be lost. When the brother demanded payment, Amundsen had to let himself be declared bankrupt. Amundsen might have been careless in financial matters but to acknowledge bankruptcy was to him equivalent to admitting that he had been guilty of criminal conduct. The bankruptcy was a blemish on his name that had to be removed and he would not rest until he had paid the last penny of his debt.

The flight to 88° North

Amundsen went again lecturing to the United States in 1924, but there the interest in his activities had also faded. Discouraged to the point of despair he figured that at the rate he was going then he would need 60 years to accumulate enough money to pay his debts and finance his new

expedition. But a miracle happened. Lincoln Ellsworth called on him, introduced himself as a person Amundsen had met in France in 1917, told him that he was interested in arctic exploration and offered to assist in financing a flight from Spitsbergen. Amundsen accepted with enthusiasm and thus an intimate co-operation and a warm friendship began.

Two Dornier-Wal flying boats, N-24 and N-25, were purchased and taken to Spitsbergen, where they started from the fast ice in King's Bay in latitude 79°N. on May 21, 1925, each carrying three men. The plan was to fly to the vicinity of the Pole and return by a slightly different route in order to explore geographically the region north of Spitsbergen. The chances were that nothing would be seen but ice, but ascertaining that no land existed would in itself be a valuable contribution.

Before the planes reached the northern islands off Spitsbergen fog shrouded the land, and for two hours the planes continued their course above the fog banks. After the fog had been left behind nothing but a monotonous expanse of sea ice could be seen. The first open leads were observed in the very early morning of the 22nd and shortly afterwards while Amundsen's plane, N-25, was circling to look for a place to go down for a position check, one of the engines failed and it became necessary to land. Both planes were brought down, but the N-24 was damaged and had to be abandoned. It was commanded by Ellsworth and had landed less than a quarter of a mile from the N-24, but the ice was so broken and treacherous that only on the fifth day could Ellsworth and his two companions, Dietrichson and Omdal, reach Amundsen's party. While struggling over the ice with heavy loads both Dietrichson and Omdall fell through, but were saved by Ellsworth's heroic efforts.

The N-25 was in grave danger because the temperature was so low that ice formed rapidly on the leads and the pack ice was in constant motion and might at any time crush the frail craft. By their combined efforts the six men succeeded in hauling the N-25 to comparative safety on a thick ice floe. Now they had a choice between trying to get the one plane into the air or working their way across the ice to the coast of Greenland, 400 miles away. Their chances of reaching Greenland were slim indeed and Amundsen decided to make every effort to prepare a runway on the ice and take off from it. For three weeks the men toiled on short rations and with inadequate tools. Leads opened and floes broke. Again and again they had to save the plane from almost certain disaster and to see their work ruined. Finally on June 6 Riiser-Larsen and Omdal found a floe large enough for take-off and on the next day the weary men went to work with new zeal. Clearing a runway of soft snow by shoveling was back-breaking, but Omdal had the bright idea of tramping the snow down. For four days the six men stamped up and down the runway. A frost on the 14th helped to harden the surface and when on the following day the weather cleared the desperate attempt had to be made. All unnecessary gear was left behind and with the six men on board and fuel for 8 hours Riiser-Larsen managed to get the plane into the air. Eight hours later he

set it safely down on the water off the north coast of Spitsbergen. The men were soon picked up by a sealer, which took them to King's Bay, where they found to their amazement a flotilla of small ships and a few planes ready to start a large-scale search for them.

During their journey along the coast of Norway Amundsen and his companions were everywhere greeted by flying flags and cheering crowds and the enthusiastic receptions reached their climax when the party arrived in Oslo on July 5. The city went wild. Amundsen had previously returned from expeditions that had given far greater results, but never from one that had appealed more to the public. What a contrast to the sneers that had met him only a year earlier!

The first flight across the Arctic Ocean

Even now Amundsen did not rest on his laurels. He had one more task to accomplish: the crossing of the Arctic Ocean. The possibility of using a dirigible had been discussed during the stay at King's Bay before the flight of 1925 and on that occasion Riiser-Larsen had directed Amundsen's attention to the Italian airship N-1 that appeared particularly well suited. In August 1925 its designer, Colonel Umberto Nobile, came to Oslo for a conference with Amundsen and Riiser-Larsen at which general agreement about the purchase of the dirigible was reached. Ellsworth helped finance the enterprise, the contracts were signed and Nobile was engaged as captain of the airship. Extensive preparations were made, including the erection of mooring masts at Oslo and Vardö and the building of a large shed at King's Bay. All went according to schedule and on May 7, 1926 the N-1, renamed the *Norge*, reached King's Bay.

At that time Byrd had already arrived in King's Bay in order to attempt a flight to the North Pole in the *Josephine Ford* airplane. Many people were wondering if there would develop a race between the airship and the airplane and if Byrd and Amundsen would both jealously hasten their last preparations in order to get off first. Actually there was no rivalry and Amundsen was happy when Byrd successfully carried out the flight to the Pole on May 9, two days before the start of the *Norge*. This attitude of Amundsen was in keeping with his previous non-committal stand in regard to the old Peary-Cook controversy.

On May 11, 1926 the *Norge* lifted her great bulk from the snow-covered slope at King's Bay and set course for Point Barrow, Alaska by way of the North Pole. The party on board numbered 16 men and included Wisting, Amundsen's companion on the journey to the South Pole, and shipmate in the *Maud*. In the early hours of May 12 the Pole was reached, where the flags of Norway, Italy, and the United States were dropped.

Between the North Pole and Point Barrow the route crossed the largest unexplored region of the Arctic, passing over what Stefansson has called the "Pole of Inaccessibility", but Amundsen preferred to refer to as the "Ice Pole". In 1911 the expert on tides, Rollin A. Harris of the U. S. Coast

and Geodetic Survey, had advanced the hypothesis that large land masses should lie in that very region. His conclusions were based on a study of the then available tidal observations, but during the *Maud* Expedition, during which comprehensive records of tides and tidal currents were obtained, it was found that Harris had reasoned from incomplete data, and that contrary to his opinion the character of the tides on the coasts of Siberia and Alaska indicated waters of great depth in the unknown region.

During the flight of the *Norge* the latter conclusion was confirmed, although the airship flew partly through fog and clouds and thus the ground could not be observed continuously. For some time the fog and clouds caused so much icing that the situation appeared critical, partly on account of the added weight and partly on account of the danger of the hull being torn by pieces of ice thrown off the propellers. Several holes were cut in the hull, but they could be repaired and the *Norge* got out of the icing zone without having suffered serious damage.

In the morning of May 13, 46 hours after the start, land was sighted, which turned out to lie just west of Point Barrow. The next 24 hours were the most trying of the whole trip. The main purpose had been accomplished and exhaustion and lack of sleep now made themselves fully felt. Still, it was necessary to travel farther south, preferably to Nome, but navigation was difficult owing to poor radio communications, reduced visibility, and, when the clouds broke, lack of landmarks in the monotonous northern landscape. Course had to be changed repeatedly, but on May 14, 72 hours after the departure from Spitsbergen, the *Norge* landed safely at Teller, Alaska, about 60 miles northwest of Nome.

On the return trip to Norway through the United States Amundsen and his companions were again hailed by great crowds, and on arriving in Oslo their enthusiastic reception equalled that of 1925. Amundsen had brought with him the Norwegian flag that the *Norge* had flown on the flight across the Arctic Ocean. When he had to speak to the thousands who had gathered to greet him he said : "Many have asked me what has spurred me to start out again and again." Unfolding the flag he went on : "Here it is. This flag has always spurred me on." Everybody who knows Amundsen also knows that this was not an idle phrase and that love for and pride of his country were parts of his being.

After the flight of the *Norge* Amundsen declared that he would no longer take an active part in exploration, but would always be at the disposal of anybody who might wish to benefit from his experiences. He wanted to live in peace at his beloved home outside of Oslo, the home which one of his friends and admirers had bought from his bankrupt estate and had placed at Amundsen's disposal for life. However, he did not find immediately the peace he had been looking for. There arose an unfortunate conflict between him and Nobile, who considered himself coleader of the *Norge* expedition, whereas according to the contracts he had been the paid captain of the airship. In his autobiography Amundsen denounced Nobile's attitude and took opportunity to give vent to some of his bitterness against

other persons who had hurt him or whose opinions he was violently opposed to.

The last flight

Amundsen's autobiography stirred up some dust and before this had had time to settle Nobile had started an expedition of his own with a sister ship of the *Norge*, the *Italia*. After a flight from Spitsbergen to Severnaya Zemlya (North Land), which did not reach its objective, the *Italia* attained the Pole on May 23, 1928, but on the return trip she was forced down and wrecked. No accurate information as to where the disaster had happened was available, but rescue operations had to be started right away. Amundsen offered his services, hoping to be put in charge of the operations to be undertaken by the Norwegian Government, but airplanes had to be used and the only suitable ones belonged to the Norwegian Navy. It was considered that they could not be commanded by a civilian and to Amundsen's great disappointment Lieutenant Riiser-Larsen, his companion in 1925 and 1926, was put in charge. Amundsen was still eager to take part in the search and he gladly agreed to go to Spitsbergen with a French plane of the Latham type, piloted by Gilbaud.

Amundsen had still one great worry left, his debts from the unfortunate years 1923-5 had not yet been paid in full. He had planned to sell his many gold medals to cover the remaining amount and before he left Oslo to join the Latham his last words to his attorney were: "Make me a free man". Before leaving Tromsö he got word that the Historical Museum of Oslo had been able to buy his collection for a sum that was barely sufficient to satisfy his creditors. He was again a free man.

Experts were convinced that the Latham was not suitable for the purpose, but time was short. Wisting and Dietrichson should both have gone with Amundsen, but there was room for only one of them and the choice fell on the flyer, Dietrichson. On June 18 the Latham left Tromsö. For a few hours radio contact was maintained between the plane and Tromsö, then silence followed. When the plane failed to reach Spitsbergen at the calculated hour, it was feared that it had been forced down at sea and that Amundsen and his companions were lost. Extensive search operations were undertaken, but only some wreckage of the plane was found. It was never learned exactly how Amundsen met death, but all that needs to be known is that he closed his career in an attempt to rescue a fellow explorer.

Appraisal

Amundsen said of himself that he never became an arctic explorer, because since he was fifteen years old all his thoughts and his energy had been directed toward one goal — the expansion of our knowledge of the polar regions. Circumstances made it necessary for him to change plans and make detours, but after he had sailed through the Northwest Passage,

his one all-absorbing idea from 1908 to 1926 was to cross the Arctic Ocean and reach the North Pole. The attainment of the South Pole was incidental.

Amundsen was not a scientist and he never claimed to be one. He was interested in securing accurate information wherever he travelled and in giving specialists opportunities to carry out observations on his expeditions, but he cared little for their conclusions and even less for their theories. When he talked about men of science he had met, he would stress their personal characteristics and not their scientific accomplishments.

Thoroughness in planning, meticulous attention to details, and nearly fussy orderliness combined with bold initiative laid the foundations for Amundsen's success. To this should be added his ability to select suitable companions and to gain their unqualified confidence in his leadership. In selecting his men he apparently looked for one particular characteristic: resourcefulness. When preparations were still in progress, he might ask a question about a difficult task or give a man an impossible assignment. If he got the answer "it can't be done" he was through with the man then and there, but if the man later returned to the matter and explained how he had tried to tackle the problem, Amundsen was satisfied even if the result was entirely negative.

On his expeditions Amundsen demanded of his men a punctuality and orderliness corresponding to his own. During the *Maud* Expedition he himself worked as cook for two years with the members of the party alternating as mess boys. Never was the galley more shining and orderly, with every pot and other utensil in its proper place. He established a strict daily routine broken only by festive occasions during which he more than anyone else knew how to create a congenial atmosphere. His men loved him.

Amundsen's financial troubles stood in sharp contrast to his meticulous orderliness in other matters. His apparent carelessness in handling money probably stemmed from his attitude that regarded money as a necessary evil of no value of its own. To this must be added that, like many other great explorers, he believed in his own mission, and when funds were not forthcoming from expected sources he was inclined to ascribe this to lack of appreciation or even to take it as a personal affront. His belief in himself was his greatest strength, without which he could not have attained his goals. This belief combined with his great sensitivity was also a weakness that in the course of time made him a bitter and lonely man. Occasionally he was imposed upon by publicity seekers and such experiences made him suspicious of anyone who approached him. He had to pay a high price for his success: his faith in human nature. Still, to his few personal friends he was the most warm-hearted, hospitable, generous, and charming person.

Few men have during their whole life followed a single line with greater perseverance or greater success. The glory of his death together with the brilliancy of his many achievements have placed Amundsen forever in the foremost rank of the great explorers.

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REVIEWS

THE UPPER TANANA INDIANS

By ROBERT A. MCKENNAN. *New Haven: Yale University. Yale University Publications in Anthropology, No. 55. 9¾ X 6¾ inches, 226 pages, 4 plates, 7 text figures, paper, $3.00.*

This is another paper in the *Yale University Publications in Anthropology* dealing with northern Athapaskan peoples. Dr. McKennan's work continues in the sound tradition established for the series. The volume presents in standard ethnographic form the results of Dr. McKennan's field work among the Upper Tanana during the season 1929-30. Each aspect of the culture of these people is described, starting with economics and ending with mythology. No criticism can be made of this approach since this is the first major study of these people and especially since at the time the field work was done this was the accepted approach to ethnographic reporting. The great need for descriptions of subarctic peoples gives value to accounts such as this, unembellished by theoretical concepts and "bones of contention".

Several minor points regarding Dr. McKennan's study should, however, be mentioned. Perhaps the most important is his remarks on the absence of hunting territories among the Upper Tanana (p. 128). Although they lack hunting territories as defined by Speck and others, the "bands" of Upper Tanana do exploit particular areas. The size of these bands, which are on the average slightly larger than the twentieth-century land-owning groups of the eastern Subarctic, does fall within the range found in the latter area. Accordingly, a variant type of hunting territory appears to exist among the Upper Tanana and it may be similar to that which existed in the eastern Subarctic at the time of the first meeting between the white man and the Indians. A second point is his discussion of clans among the Upper Tanana. The inclusion of specific case material to document the organization and structure of these clans would have been welcome. Third, there are a few statements that are misleading, for instance, p. 18, "Tetling Village, nine miles 'south' of Last Tetling . . . ." should read 'north'; p. 71, his description of the winter lodge is confusing and only becomes intelligible when he quotes Tappan Adney.

The above comments are not meant to detract from Dr. McKennan's work. It is a sound ethnographic study, well written, and certainly a worthwhile contribution to the literature pertaining to the peoples of the Subarctic.

EDWARD S. ROGERS

RUSSIAN-ENGLISH GLOSSARY AND SOVIET CLASSIFICATION OF ICE FOUND AT SEA.

Compiled by BORIS N. MANDROVSKY. *Washington: Reference Department, Library of Congress. 1959. 10¼ X 8 inches; vi + 30 pages; mimeographed; $0.30; obtainable from Card Division, Library of Congress, Washington 25, D.C.*

This useful work reproduces and provides English equivalents for the sea ice terms in N. I. Yevgenov (Evgenov, according to the system of transliteration used by the Library of Congress and in *Arctic Bibliography*): *Al'bom ledovykh obrazovaniy na moryakh* (Leningrad, 1955), now in official Soviet use. The English equivalent terms, often exact fits, are those in current United States use, taken from Hydrological Office Publication No. 609: *A functional glossary of ice terminology* (Washington, 1952), or failing that, from the World Meteorological Organization Publication: *Abridged international ice nomenclature* (Geneva, 1956). Some of the divergences between the three systems

become apparent; in particular the compiler's chart showing three sets of definitions of terms for size and concentration of floes are interesting. At first one is saddened to see how two countries that both approved the W.M.O. classification and nomenclature in practice ignore it. But perhaps after all it is the amount of common ground between them that is the more noteworthy. One point of detail might be mentioned. For the Russian *"massiv l'da"* the compiler rejects this reviewer's term "ice cluster". Agreed that it could be improved; but is "pack, or ice pack" in fact any better, in view of likely confusion with "pack ice", which means something rather different?

TERENCE ARMSTRONG

SCHAMANENTUM (SHAMANISM).

By HANS FINDEISEN. *Stuttgart: W. Kohlhammer Verlag, Urban-Bücher No. 28. 1957. 7¼ X 4½ inches, 240 pages, sketch map, 4 plates with 14 Figs. Paper, DM 4.80.*

DAS TIER ALS GOTT, DAEMON UND AHNE (THE ANIMAL AS GOD, DEMON, AND ANCESTOR)

By HANS FINDEISEN. *Stuttgart: Frankh'sche Verlagshandlung, Kosmos-Bändchen. 1956. 7½ X 5 inches, 80 pages, 14 Figs., DM 2.80.*

Hans Findeisen is a German ethnologist specializing in the peoples of northern Asia. His record of publications extends over three decades, and among his earliest writings is an excellent article on fishing in northeastern Siberia; in it he relates the economic activity to the social, religious, and artistic life of the Palaeo-Asiatic peoples (Die Fischerei im Leben der altsibirischen Völkerstämme. Z. Ethn. 1928, 1/3).

During the past decade Findeisen has published a number of books and articles, usually brief, on shamanism in northern Asia. A recent publication, "Siberian shamanism and magic," first issued in 1953 (Sibirisches Schamanentum und Magie, Inst. für Menschen- und Menschheitskunde, Augsburg, 2nd ed. 1958) has a technical purpose: Findeisen rejects the oft-proposed relationship between magic and shamanism and attributes to the Siberian shaman a direct relationship with spirits, mediums, and parapsychological practitioners of western cultural tradition. Findeisen has been working closely with a spirit medium, Alfred M. of Augsburg and joins this sphere of investigation to that of shamanism.

The relationship between shamanism and spiritism has recently been developed by him in the first book under review, a popular paperback, "Shamanism", 1957. Here he proposes that the shaman is an Upper Palaeolithic priest possessed by spirits. The relationship of the shaman's practice with hunting magic has been suggested by Findeisen in yet another study, "The animal as god, demon and ancestor".

The parallel that Findeisen draws between shamanism and the practice of the spirit medium appears to me to defy usual ethnological procedure. In all his descriptions the folk or public plays no role. The cultural context is not sketched in. The relationship of shamanism to psychiatry on one side and to religion on the other is not treated. Moreover, Findeisen has not resolved his views on the relationship between shamanism and magic. This relationship may be (a) erroneous, (b) genetic, but later divergent; or (c) inherent and inseparable. Findeisen appears to adopt in recent times now view (a) and now view (b); view (c) is firmly rejected, but chiefly by appeal to authority (Ruth Benedict and others).

Considering the Upper Palaeolithic priest possessed by spirits as a shaman can lead to confusion. In counterposition to this point it may be suggested that the term priest should be reserved for members of a religious hierarchy trained for their role. The shaman is sometimes trained, but he is characteristically charismatic, he is not a member of a religious community or hierarchy.

There is an alternative view, namely, that shamanism is neither a magical nor a religious phenomenon, but a proper

world-view in itself. This concept has been advanced by Shirokogorov, but it is not taken into account by Findeisen.

There are a number of relationships within shamanism that should be explored further. There is the viewpoint of Shirokogorov; Anisimov has recently examined the religion of the Evenki Tungus in terms of their shamanist practices. Ivanov has reviewed the problem of shamanist artistic creation and society. The reviewer has analyzed the problem of the relation of shamanism and the social organization of the Buryats. These are attempts to develop cultural phenomena in their contexts.

Outside the field of ethnology there is the relation of the shaman's experience to psychiatric phenomena. If the shaman is abnormal and the society still puts him to use as a specialist whose activities are made possible by his very abnormality, then this is a psychiatric conception that departs sharply from that of western culture and requires intensive exploration. Attention should be called to the work of Frederick Wyatt and G. Devereux in this regard.

The thesis of Findeisen concerning the relationship between shamanism and spiritism will persuade those already persuaded, but leave unconvinced those of the ethnological fraternity who seek to develop cultural phenomena in their context. To this fraternity Findeisen belongs by right of his earlier publications.

LAWRENCE KRADER

INSTITUTE NEWS

Annual Meeting of the Board of Governors

The Annual Meeting of the Board of Governors was held at the Institute Headquarters in Montreal on December 5, 1959. The following were elected for 1960:

Officers of the Board: Chairman, Dr. C. S. Lord, Geological Survey of Canada, Ottawa, Ont.; Vice-Chairman, Commander D. C. Nutt, Dartmouth College, Hanover, N.H.; Secretary, Dr. M. J. Dunbar, McGill University, Montreal, P.Q.; Treasurer, Commodore C. F. Robertson, Canadian Joint Staff, Washington, D.C.

Governors elected by the Fellows of the Institute: Dr. M. J. Dunbar, McGill University, Montreal, P.Q.; Dr. J. T. Wilson, O.B.E., University of Toronto, Toronto, Ont.; Dr. H. B. Collins, Jr., Smithsonian Institution, Washington, D.C.

Governors appointed by the Board: Commander D. C. Nutt, Dartmouth College, Hanover, N.H.; Paul Queneau, International Nickel Company, New York, N.Y.; Dr. Paul A. Siple, Army Research Office, Washington, D.C.; Dr. O. M. Solandt, Canadian National Railways, Montreal, P.Q.; Walter Sullivan, New York Times, New York, N.Y.; Dr. Walter A. Wood, New York, N.Y.

Retiring Governors: Philip A. Chester, Dr. J. C. Haldeman, T. H. Manning, J. R. White.

The 1959 Institute library report

The library of the Arctic Institute has completed another year of increased activity. Statistics show that the library has grown in size and that its use has increased considerably. In the last five years the library has doubled its collection of books, pamphlets, reprints, and serials.

Circulation	1959	1958
Books	1258	1110
Reprints and pamphlets	237	355
Periodicals	524	506
Interlibrary loans lent	184	77
Total	2203	2048
Interlibrary loans borrowed	39	41

Accessions

Volumes received	440	351
Reprints and pamphlets received	381	321
Serials received	2580	1278
Volumes accessioned	656	762
Total bound volumes in library	3672	3062

The holdings of periodicals are increasing faster than any other part of the library. The library has been fortunate enough to be able to arrange several exchanges with libraries in the Soviet Union, Denmark, Japan, and the People's Republic of China. Holdings of Russian material on arctic and antarctic subjects are becoming more important as interest increases in Soviet scientific achievements and the library of the Arctic Institute is making every effort to acquire Russian material. Translations are also eagerly collected. It is hoped that soon the library can add the translation of important material as one of its services.

As in the past the library's holdings have been listed in the "Union Catalogue, Bibliographic Centre of the National Archives of Canada". In addition, the holdings of serials are now being listed in the new edition of the *Union List of Scientific Serials in Canadian Libraries;* they will be included in the new edition of the *Union List of Serials* that is being prepared by the Library of Congress and they are also regularly listed in their *New Serials Titles.* They are also listed in the union catalogue of serials held in the Reference Department of McGill University.

Furthermore, the library has continued its policy of issuing a bi-monthly list of recent accessions, which is available free of charge on request to the librarian.

As in the past the members of the Arctic Institute have not availed themselves to any extent of the resources of the library, although scientific, technical, and historical books are complemented by many of a more general nature. However, the library is continuously used by students and faculty members of the local universities and by the staff of the Institute, as well as by libraries all over Canada and the United States through interlibrary loans.

Reference questions are received in great quantity and they have wide range and great variety, for example: "Where is Grice Fiord and what would be the circumstances of the life of a young Eskimo living there?" "Are there new figures on the depth of sea ice in the Ross and Wedell seas for the past year?" "What has been written on the stratigraphic geology of Ellesmere Island?" "Do we have a detailed map of Novaya Zemlya?" "Who was Hans Egede?"

The library encourages direct use of its reference facilities, but also welcomes all questions by letter and telephone. However, for long and involved searches, such as one tackled last summer on special aspects of the Canadian arctic islands, a charge has to be made on a cost basis.

The library was visited by many renowned arctic specialists during the year. In August, during the sessions of the IXth International Botanical Congress in Montreal, many well-known botanists were welcomed. The Russian delegation spent an afternoon in the Institute and donated several publications that were not yet on the library shelves.

The library is very fortunate in having members of the Institute remember to donate reprints of their papers. As the library cannot keep runs of all periodicals these gifts are invaluable in maintaining complete coverage. Acknowledgement of all gifts is made regularly in *Arctic.*

It is hoped that 1960 will see increased use of the library and all its various services.

Complimentary copies of the following serial publications have been gratefully received during the past year:

Actividad antártica argentina

Alaska Historical Library and Museum. Biennial Report

Alaska Resource Development Board. Alaska Passenger Traffic Survey

Alaska Resource Development Board. Biennial Report

Alaska Resource Development Board. Estimate of Alaska Population

Alaska Resource Development Board. Financial Data . . . Towns and Cities of Alaska

Alaska University. Arctic Research Laboratory. Progress Report

Alaska University. Biological Papers

Antarctic Record

Canada Defence Research Board. Translations

Canada Department of Mines and Technical Surveys. Geographical Branch. Bibliographical Series

Canada Department of Northern Affairs and National Resources. Annual Report

Canada Department of Northern Affairs and National Resources. Editorial and Information Division. New Releases

Canada Department of Northern Affaire and National Resources. Water Resources Division. Water Resources Papers

Canadian Geophysical Bulletin

C.I.L. Oval

Falkland Islands and Dependencies. Meteorological Service. Annual Meteorological Tables

Falkland Islands Dependencies Survey. Scientific Reports

Finlandia Pictorial

France. Comité national français des recherches antarctiques. Circulaire

Geophysical Research in Norway

Greenland. Chief Medical Officer. Annual Report: The State of Health in Greenland

Greenland. Tekniske organisation. Publication

Institut für Menschen- und Menschheitskunde. Abhandlungen und Aufsätze

International Commission for the Northwest Atlantic Fisheries. Annual Proceedings

International Commission for the Northwest Atlantic Fisheries. Statistical Bulletin

International Geographical Union. Commission de géomorphologie appliquée. Circulaire

International Geographical Union. Commission de géomorphologie périglaciaire. Circulaire

IGY Bulletin

International Union of Geodesy and Geophysics. Newsletter

Inuktitut

J. L. News

McGill University. Arctic Meteorology Research Group. Publications in Meteorology

McGill Subarctic Research Papers

Münchner Geographische Hefte

National Bank of Iceland, Reykjavik. Statistical Bulletin

National Museum of Canada. Bulletin

National Research Council of Canada. Associate Committee on Soil and Snow Mechanics. Proceedings

National Research Council of Canada. Associate Committee on Soil and Snow Mechanics. Technical Memorandum

National Research Council of Canada. Division of Building Research. Research Papers.

National Research Council of Canada. Division of Building Research. Technical Papers

Newfoundland. Department of Mines and Resources. Annual Report

Northern Affairs Bulletin

Northwest Territories. Ordinances

Northwest Territories. Power Commission. Annual Report

Polar Notes

Polarboken .

Quebec. Department of Mines. Geological Surveys Branch. Preliminary Reports

The Roundel

Royal Bank of Canada. Newsletter

Royal Canadian Mounted Police. Reports

Sapporo, Japan. Hokkaido Imperial University. Faculty of Science. Journal

Sapporo, Japan. Hokkaido Imperial University. Institute of Low Temperature Science. Contributions

SCAN

Screenings from the Soil Research Laboratory

Service de biogéographie. Bulletin

Sociedad geográfica de Colombia. Boletín

Sociedad geográfica de Lima. Boletín

Soviet News Bulletin

Swiss Foundation for Alpine Research. Journal

U.S.S.R. Illustrated News

U.S. Hydrographic Office. Technical Reports

Les variations des glaciers suisses
Ward Index of Consumer Prices in . . . Alaskan Cities
Wildlife Management Bulletin, Series 1
Yukon Territory. Ordinances

NORA CORLEY, B.A., B.L.S.,
Librarian.

Gifts to the library

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NORTHERN NEWS

Geomorphological studies in the Torngat Mountains, northern Labrador

In the summer 1959 I carried out studies of the glacial morphology in the Torngat Mountains assisted by Arve Fiskerstrand of the University of Oslo. Eight weeks were spent in the field, from mid-July to mid-September.

Bad weather prevented us from reaching the site that had been intended for the base camp. Camp was finally set up at Two Loon Lake, approximately 5 miles southwest of the southern end of Ryans Bay. From this camp and from a depot at Upper Kangalaksiorvik Lake several short trips of 3 to 7 days each were made into the surrounding areas.

An upper trimline and a lower level characterized by kame terraces similar to those described from the area northwest of Saglek Bay (Ives, J. D.: Glacial geomorphology of the Torngat Mountains, northern Labrador. Geog. Bull. No. 12, 1958) were recognized in the through valleys, where they lay 700 to 800 ft. lower than in the Seglek region. Other marked stages in the deglaciation of the area were found. At two places at the southern end of Ryans Bay fluvial terraces, built up to sea-level in front of the retreating glacier, were examined. These terraces made it possible to correlate stages in the deglaciation to the sea-level at that particular time. It is hoped that further studies of this problem will give a better understanding of the late-glacial and post-glacial uplift in the area and thus make it possible to compare stages of the retreat of the ice in the various valleys.

A very well-developed shoreline was found 161 ft. above present sea-level. The significance of this will not be clear until more field work has been done.

A large number of cirques was examined and considerable differences in their late-glacial and post-glacial development were recognized. Of great interest is a set of "fresh-looking" moraines, indicating the existence of relatively recent and extensive ice masses in the cirques around Band mountain.

Lichens were collected from several of the morainic features. Dr. Beschel of Queen's University, Kingston has kindly offered to examine them, and it is hoped that they will give approximate dates for the various features.

A number of plants that were collected during the field season will be examined by Drs. Löve of the University of Montreal.

The weather was very good and on only 3 days during the 8-week season was it impossible to work in the field because of bad weather.

Polar bears were encountered on 4 different days. A mother and her two cubs were seen about 20 miles from the sea, and it is believed that they stayed in the same area for at least 3 weeks.

The field work was made possible by a grant from the Banting Fund administrated by the Arctic Institute of North America. Transportation from North West River to the Torngat Mountains and back was kindly provided by the British Newfoundland Exploration Ltd. and I am much indebted to Dr. Beavan for his generous help.

OLAV LØKEN

A histo-physiological study of the reaction of the *Gammarus* eye to different light and temperature conditions. A comparison of this reaction with the behavioural responses and rates of oxygen consumption.

Preliminary experiments were conducted in January 1959 at the Biological Station, St. Andrews, N.B. in order to get a better understanding of the project. The results of these experiments indicate that the retinal pigment of *Gammarus* shows some movement and that

in constant darkness there is a definite diurnal rhythm in its position.

In the later part of June and in early July 1959 Mrs. D. H. Steele, the research assistant, and the writer carried out the following experiments in the Defence Research Northern Laboratory, Fort Churchill, Man. *Gammarus oceanicus*, collected in that area, were subjected for one and one-half hours to temperatures of 2°, 6°, 11°, and 20°C. and illuminations of 0.0001, 0.001, 0.01, 0.1, and 1 ft-c., and sampled. Their rates of oxygen consumption under these conditions were also studied. In addition, experiments were designed to ascertain whether the retinal pigment displayed any diurnal rhythm in its position, when the animals were subjected to constant light or darkness.

The eyes of the animals sampled are being sectioned, stained, and examined, and the data concerning oxygen consumption will be analysed. A detailed report will be published later.

M. A. ALI

Glaciological and Botanical Studies in northern Ellesmere Island, 1959

The writers spent the summer season from May 18 to August 18 in the region of the Gilman Glacier, about 82°08′N. 70°57′W., in northeastern Ellesmere Island. The investigations undertaken under a Banting grant in aid were mainly complementary to the glaciological and botanical work of the expedition "Operation Hazen" sponsored by the Defence Research Board of Canada in 1957-8.

The work of the party can be divided into four separate phases. After arrival at the Gilman Glacier camp of 1958 on May 18 supplies and equipment were moved from there to a new camp at the glacier snout. Some food and other stores were cached on a nunatak at the east side of the glacier. During this period all ablation and movement stakes that had been established in 1957-8 were visited by Sagar in order to gather ablation and accumulation data for 1958.

By June 1, after the base camp had been established some 120 yards from the glacier snout, a series of meteorological and radiation observations was started, but a full program could not be begun until June 13 after all installations had been completed. During this second period the ablation stakes on the lower 8 miles of the glacier were examined. Additional ablation stakes were installed in the face of the snout. Botanical reconnaissance surveys of the snout area and neighbouring slopes were made by Powell.

From June 13 to August 5 systematic series of synoptic and micro-meteorological readings were taken, but they were occasionally interrupted by other duties or by breakdown of equipment. Surveys of the glacier terminus, visits to a nearby drift glacier and to a small valley glacier were also made. Investigations of plant ecology and of plant communities in specific areas of the Lake Hazen-Gilman Glacier region were carried out.

Less detailed meteorological observations only could be undertaken from August 6 to 17 after heavy and bulky equipment had been removed by helicopter to the USCGS icebreaker *Westwind*. Dr. G. F. Hattersley-Smith joined the party during this final period and took part in the glaciological work. All glacier stations were revisited in order to collect ablation data. Late summer plant and seed collections were made by Powell.

The party left the glacier camp on August 18 and walked to the east shore of Lake Hazen where they were picked up by an R.C.A.F. plane on the 24th.

A preliminary examination of the glaciological data allows one to draw certain conclusions. A direct comparison with some relevant records of 1957 and 1958 shows that accumulation of snow was approximately the same in each of the three years. In 1959 ablation was appreciably less than in 1958 and still more so than in 1957. The ablation season of 1959 was shorter and probably cooler than those of 1957 and 1958. Linear snout recession due to melting was relatively small in 1959. The present morphology of the glacier terminus indicates that a slight readvance of the ice

during a whole year may be taking place at present. A close relationship between the amount of ablation over the lower part of the glacier and the solar radiation income was observed. It is hoped to present the results of the glaciological investigations in full in a later paper, in which both the ablation process and the structural changes at the snout will be discussed.

The botanical studies served to confirm distributional features noted before. Further ecological and phenological notes on flowering plants were taken and collections of all the species found were made. The collections of higher plants and less complete collections of mosses, lichens, and fungi have been deposited in the National Museum of Canada. Among the collections are a number of holarctic range extensions. The phenological data for 1959 as compared with those for 1958 support the evidence that the summer of 1959 was cooler than that of the previous year. This is also indicated by the fact that the snow melt was appreciably later in 1959 than in the two preceding years.

This work was made possible through grants from the Banting Fund and support by the Defence Research Board of Canada, to both of which the writers wish to express their gratitude.

J. M. POWELL
R. B. SAGAR

Obituary

PAUL WALKER 1934-1959

Paul Walker was a research scientist who had worked for the Arctic Institute in the Arctic and the Antarctic. He was born in California and graduated from Occidental College, Los Angeles in 1956, majoring in geology. He had visited Alaska and already spent one summer in Greenland before graduating. On leaving college he took part in the work at Red Rock Lake, Greenland, helping to map shear zones in ice cliffs. In October 1956 he went to Antarctica to participate in the I.G.Y. program. Based at Ellsworth Station he worked on the Filchner Ice Shelf, and was selected to go with the traverse party, which covered 1,100 miles in 80 days in the area south and west of the base. Walker returned to the U.S. in 1958 to help with the compilation and analysis of glaciological and geological data from Antarctica that was being undertaken at Ohio State University. In 1959 he was appointed glaciologist with the U.S.A.F. Ellesmere Island Ice Shelf Project. He went into the field with the party in May and in early August was paralysed by a brain seizure. Flown out by light aircraft on August 10, 1959, he was taken to California. An operation brought only temporary relief and he died after great suffering, paralyzed and nearly blind, in hospital a few months later.

Paul Walker was young scientist of great promise, a hard and careful worker in the field, and the best of companions. His death is a great loss in a very real way to the polar world he loved.

The Canadian Board on Geographical Names has approved the name "Walker Hill" for the prominent 1400-foot feature on Ward Hunt Island, named in commemoration of Paul Walker by his companions.

JIM LOTZ

Activities of the Geographical Branch in northern Canada, 1958 and 1959*

An outline of the geographical studies of the Geographical Branch in northern Canada from 1947 to 57 was published in *Arctic* 10:246-50. This note summarizes the activities and publications of the Branch concerning this area in 1958 and 9.

Terrain analysis and physiographic studies

Physiographic studies of Melville Peninsula[1] were continued in 1958 and 9 by V. W. Sim[2,3]. In 1958 Sim, assisted by R. Moskal, investigated the northwest coast and north central interior

* Published with the permission of the Director, Geographical Branch, Canada Department of Mines and Technical Surveys, Ottawa, Ont.

and the following summer he examined the southern part of the peninsula, working out of Repulse Bay. J R. Mackay[4 5 6 7] continued his studies of the Mackenzie Delta area in 1958, investigating the outer delta at Richards Island and the smaller Hendrickson, Kendall, and Garry islands. Physiographic and settlement studies were carried out in the Peel River area by W. E. S. Henoch, assisted by D. H. Brown, in 1958 working from Fort McPherson. J. K. Fraser, assisted by J. W. Maxwell, studied the terrain elements in the vicinity of seven DEW Line stations in the Western Arctic in 1958 and spent the later part of the summer in northern Boothia Peninsula. J. D. Ives[8] was employed by the Branch in 1958 to extend his geomorphological studies of northern Quebec in the Indian House Lake and Helluva Lake areas. In 1959 D. St-Onge[9], assisted by R. Moskal, examined ground ice occurrences near Isachsen, Ellef Ringnes Island, the erosional processes in gypsum domes on the island, and commenced a program of geomorphological studies in the area in connection with the Polar Continental Shelf Project.

A long-term project involving detailed studies of periglacial phenomena and processes was inaugurated in 1959 at Resolute, Cornwallis Island by F. A. Cook[10 11], assisted by J. I. Romanowski. M. Brochu[12] represented the Branch at the I.G.Y. base of the Defence Research Board at Lake Hazen in Ellesmere Island during the summer of 1958, where he carried out studies in periglacial geomorphology and in glacier morphology on Gilman Glacier.

Ice studies

K. C. Arnold, attached to the Polar Continental Shelf Project of the Canada Department of Mines and Technical Surveys at Isachsen, Ellef Ringnes Island during the spring and summer of 1959, carried out glaciological investigations on the Meighen Island ice-cap and made a quantitative controlled study of the effect of dusting with various materials on the acceleration of the thawing of sea ice. W. A. Black[13 14] accompanied the C.G.S. *D'Iberville* in 1958 on the Resupply Mission of the joint Canada-U.S. weather stations to plot the ice conditions encountered and relate them to climatic factors.

Settlement and area economic studies

R. T. Gajda travelled on the C.G.S. *D'Iberville* to Resolute in 1959 and carried out site surveys in Lancaster Sound, returning to Quebec aboard the C.G.S. *C. D. Howe*. B. Robitaille[15] undertook settlement studies and geomorphological work at 22 settlements while accompanying the C.G.S. *C. D. Howe* in 1959, and spent a week at Assistance Bay, Cornwallis Island to extend his 1956 studies. G. Falconer, assisted by J. Chalk, commenced a two-year survey of the physiography and native economy along the east coast of Hudson Bay in 1959. Operating from Great Whale River the party conducted traverses inland and made whaleboat trips to Cape Jones in the south, and north to Richmond Gulf. W. A. Black, assisted by W. Atkinson, made a survey of economic conditions in the Mackenzie Delta and lower Mackenzie River area in 1959 for the Department of Northern Affairs and National Resources.

Office projects

Office projects include the continuation of the Canadian Ice Distribution Survey and the Terrain Collation Mapping Project. An annotated list of expeditions and surveys from 1919 to 59 that contributed to the knowledge of the geography of the Canadian Arctic is being compiled, and a glossary of periglacial terms is in preparation.

Publications resulting from previous surveys or from office research include those by Gajda[16], Fraser[17 18 19], Hare[20], Cook[21 22 23], Bird[24], Fraser and Henoch[25], Robitaille[26], and Henoch[27]. An article by N. L. Nicholson[28] appeared in an issue of the Canadian Geographical Journal devoted to the Canadian North. Robitaille[29] contributed to a symposium on applied geography at Laval University in 1958.

J. KEITH FRASER

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[2]————1958. Geographical Branch survey on Melville Peninsula, 1958. Arctic Circular 11:71-4.

[3]————Geographical Branch survey in southern Melville Peninsula, 1959. Arctic Circular (in press).

[4]Mackay, J. R. 1958. The valley of the lower Anderson River, Northwest Territories. Geog. Bull. No. 11:37-56.

[5]————Glacier ice-thrust features of the Yukon coast. Geog. Bull. No. 13 (in press).

[6]Mackay, J. R. and J. K. Stathers. 1959. Birds observed on a canoe journey up the Anderson River to about 150 miles from its mouth, August 3 to 13, 1955. *In* Höhn, E. O. Birds of the mouth of the Anderson River and Liverpool Bay, N.W.T. Can. Field Nat. 73:93-114.

[7]Mackay, J. R. 1958. Mackenzie Delta coastlands. Yearbook, Assoc. Pacif. Coast Geog. 20:53-4.

[8]Ives, J. D. 1959. Glacial drainage channels as indicators of late-glacial conditions in Labrador-Ungava. Cahiers de géog. de Québec, Oct. 1958-Mars 1959, pp. 57-72.

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[13]Black, W. A. 1958. A report on sea-ice conditions in the Eastern Arctic, summer 1957. Geog. Pap. No. 15, Geog. Branch, Ottawa, 32 pp.

[14]————1959. A report on sea-ice conditions in the Eastern Arctic, summer 1958. Geog. Pap. No. 20, Geog. Branch, Ottawa, 36 pp.

[15]Robitaille, B. Aperçu géomorphologique de la rive québecoise du Détroit d'Hudson. Revue can. de géog. (in press).

[16]Gajda, R. T. 1958. Cryoconite phenomena on the Greenland ice cap in the Thule area. Can. Geog. No. 12:35-44.

[17]Fraser, J. K. 1959. Freeze-thaw frequencies and mechanical weathering in Canada. Arctic 12:40-53.

[18]————1958. Physiographic regions of Boothia Isthmus, N.W.T. Geog. Bull. No. 12:19-38.

[19]————1958. Eskimo stone structures. Geog. Bull. No. 12:77-80.

[20]Hare, F. K. Photo-reconnaissance of Labrador-Ungava. Mem. No. 6, Geog. Branch, Ottawa (In press).

[21]Cook, F. A. 1958. Selected bibliography on Canadian permafrost: annotations and abstracts. Bibliog. Ser. No. 20, Geog. Branch, Ottawa, 23 pp.

[22]————Review of the study of periglacial phenomena in Canada. Geog. Bull. No. 13 (in press).

[23]————Some types of patterned ground in Canada. Geog. Bull. No. 13 (in press).

[24]Bird, J. B. and M. B. Bird. Bathurst Inlet, N.W.T. Mem. No. 8, Geog. Branch, Ottawa (in press).

[25]Fraser, J. K. and W. E. S. Henoch. 1959. Notes on the glaciation of King William Island and Adelaide Peninsula, N.W.T. Geog. Pap. No. 22, Geog. Branch, Ottawa, 38 pp.

[26]Robitaille, B. Présentation d'une carte géomorphologique de la région de Mould Bay, Ile du Prince-Patrick, Territoires du Nord-Ouest. Can. Geog. No. 15 (in press).

[27]Henoch, W. E. String bogs in the Arctic. Geog. J. (in press).

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[29]Robitaille, B. La géographie physique appliquée à la direction de la géographie, Ministère des Mines et des Relevés Techniques du Canada. Cahiers de géog. de Québec, Oct. 1958-Mars 1959, pp. 23-7.

ELECTION OF FELLOWS

At the Annual Meeting of the Arctic Institute held in Montreal on December 5, 1959 the following were elected Fellows of the Institute:

Dr. D. C. Archibald, Canadian Meteorological Service, Toronto, Ont.

Mr. A. T. Belcher, Arctic Institute of North America, Montreal, P.Q.

Dr. J. Glenn Dyer, Polar Operations Division, U.S. Weather Bureau, Washington, D.C.

Dr. K. E. Eade, Geological Survey of Canada, Ottawa, Ont.

Dr. R. P. Goldthwait, Department of Geology, Ohio State University, Columbus, Ohio.

Dr. F. A. Pitelka, Museum of Vertebrate Zoology, University of California, Berkeley, California.

Dr. O. M. Solandt, Canadian National Railways, Montreal, P.Q.

Mr. Walter Sullivan, The New York Times, New York, N.Y.

Dr. Hans Weber, University of Alberta, Edmonton, Alta.

GEOGRAPHICAL NAMES IN THE CANADIAN NORTH

The Canadian Board on Geographical Names has adopted the following names and name changes for official use in the Northwest Territories and Yukon Territory. For convenience of reference the names are listed according to the maps on which they appear. The latitudes and longitudes given are approximate only.

Norwegian Bay 59 SW and 59 SE
(Adopted May 7, 1959)

Gull Head	76°23′N.	88°43′W.	not Maageberget (head)
Milne Peak	77°12′	95°55′	not Milne Mountain
Jaeger River	77°45′	93°55′	not Paradise River

Fort Reliance 75 K/16
(Adopted June 4, 1959)
Name confirmation

Reliance (settlement)	62°47′N	109°10′W.	not Fort Reliance (settlement)

Chart 5703 Cape Baring to Cambridge Bay
(Adopted June 4, 1959)
Name confirmations

Clouston Bay	69°08′N.	113°35′W.	
Rymer Point	69°10′	113°39′	not Rhymer Point

Chart 5470 Belcher Islands
(Adopted June 4, 1959)

North Belcher Shoals	57°06′N.	80°02′W.
Radar Island	56°57′	79°42′
Lukisee Islands	56°48′	79°34′
The Bluff (bluff)	56°35′	79°16′
Claw Point	56°37′	79°09′
Mosisee Point	56°36′	79°09′
Twin Cairns Island	56°31′	78°47′
Young Point	56°21′	78°55′
Tragedy Point	56°19′	78°54′
Range Island	56°25′	78°50′
Burwash Point	56°23′	78°48′
Meeko Point	56°14′	78°51′
Dove Island	56°13′	78°52′

Bradbury Island	56°14′	78°53′	
Karlay Island	56°10′	78°55′	
Mata Island	56°10′	78°55′	
Quorik Point	56°13′	78°40′	
Fair Island	56°06′	78°56′	
Johnnys Island	56°05′	78°56′	
Rainbow Point	56°05′	78°57′	
Sala Point	56°02′	78°56′	
Camp Islands	55°55′	79°05′	
Four Steps Hill	56°24′	78°43′	
Blocked Passage	56°32′	79°07′	
Face Channel	56°15′	79°04′	
Deposit Cove	56°01′	79°02′	
Isaacs Lake	56°11′	78°51′	
Rock Passage	55°51′	79°13′	
Salt Lake	55°59′	79°01′	
Ridge Passage	55°47′	79°07′	
Narrow Passage	55°41′	79°16′	
Split Island	56°51′	79°51′	not Banks Island
Laddie Island	56°53′	79°41′	not Dorothy Island
Desgoffe Point	56°21′	78°50′	not Low Point
Nero Island	56°12′	78°54′	not Doutt Island
Salty Hill	56°18′	78°46′	not Cruickshank Hill
Power Lake	56°16′	78°47′	not Generator Lake
Mine Lake	55°54′	79°03′	not Gauvreau Lake
Red Fox Cove	55°44′	79°20′	not Fox Cove

Fort Resolution 85 H
(Adopted June 4, 1959)

Outpost Island (settlement)	61°44′N.	113°28′W.	
Ring Lake	61°13′	113°06′	
Rat River	61°07′	112°36′	not Ruisseau Pierrot
Jerome Slough	61°06′	112°40′	not Ruisseau Jérôme nor Jerome Creek

Herschel 117 SW and 117 SE
(Adopted June 4, 1959)

Difficult Creek	69°31′N.	139°21′W.	
Welles Point	69°33′	139°17′	
Avadlek Spit	69°34′	139°15′	
Ptarmigan Bay	69°27′	139°02′	not Katgealuk Bay
Okpioyuak Creek	69°22′	139°29′	not Willow Creek
Kugaryuk Creek	69°30′	139°23′	not Small Creek
Nunaluk Spit	69°34′	139°32′	not Yoyak Spit
Niakolik Point	69°15′	138°29′	not Head Point
Whitefish Station (locality)	68°54′	136°54′	not Niakonat (locality)
Name confirmations			
Herschel Island	69°35′	139°00′	not Kikektaoyok Island
Firth River	69°32′	139°32′	not Kauktaluk River
Shingle Point	69°00′	137°27′	not Tapkok Point
King Point	69°07′	137°52′	not Kingak Point
Blow River	68°57′	137°05′	not Titiguvyoak River
Stokes Point	69°21′	138°42′	not Ikpigyuk Point
Kay Point	69°18′	138°22′	not Tikagak Point
Sabine Point	69°04′	137°44′	not Umigovik Point
Escape Reef	69°00′	137°15′	not Akpayuatichak Reef
Clarence Lagoon	69°37′	140°49′	not Kainiovik Lagoon
Tent Island	68°55′	136°33′	not Avadlek Island
West Channel	68°53′	136°10′	not Igaveet Channel
Komakuk Beach	69°37′	140°06′	not Bagnall Beach nor Komakok Beach

Port Brabant 107 SW and 107 SE
(Adopted June 4, 1959)

Fish River	68°39′N.	135°52′W.	
Rock Channel	68°42′	135°59′	
Hvatum Channel	68°45′	135°37′	
Beaver House Creek	68°26′	135°32′	
Nikoluk Channel	68°25′	135°14′	
Jamieson Channel	68°25′	135°00′	

Tiktalik Channel	68°50′	135°56′	not Tiktaluk Channel
Name confirmation			
Oniak Channel	68°34′	133°59′	not Uniak Channel

Sverdrup Islands 69 N½ and 59 N½
(Adopted June 4, 1959)

Station Bay	78°43′N.	103°55′W.	
Thor Island	78°12′	103°00′	
Dome Bay	78°20′	103°00′	
Name confirmation			
Meteorologist Peninsula	78°00′	100°00′	not Nathorst Peninsula

Borden Island 89 NE and 79 N½
(Adopted June 4, 1959)

Isachsen Peninsula	79°10′N.	104°45′W.	
Hospital Bay	78°58′	105°00′	
Noice Peninsula	78°27′	104°35′	

Chart 5470 Belcher Islands
(Adopted July 2, 1959)
Name confirmations

Loaf Island	56°40′N.	78°47′W.	not Twomey Island
Bun Island	56°37′	78°45′	not Quimby Island
Cake Island	56°35′	78°47′	not Mackenzie Island

Melville North 47 SW and 47 SE
(Adopted July 2, 1959)

Hall River	68°42′N.	82°39′W.	
Kingora River	68°36′	82°40′	
Kidney Bay	69°22′	85°22′	
Tuktu Bay	68°08′	85°53′	not Caribou Bay

Prince of Wales Island 68 SW and 68 SE
(Adopted July 2, 1959)

Beams Brook	73°03′N.	98°10′W.	
Maze Islands	73°01′	98°00′	
Scarp Brook	72°58′	98°25′	
Dolphin River	72°55′	98°18′	
Crooked Lake	72°36′	98°18′	
Young Bay	72°40′	96°56′	
Pandora Island	72°47′	96°47′	
Muskox Hill	72°47′	97°22′	
Reliance Bay	73°47′	100°23′	
Birthday Bay	73°50′	97°15′	
Cape Brodie	72°23′	96°16′	
Home Point	72°55′	98°21′	
Allen Lake	73°34′	98°28′	
Le Feuvre Inlet	72°15′	96°42′	
Smith Bay	73°10′	100°30′	not Cape Smith Bay nor C. Smith Bay
Back Bay	73°32′	97°11′	not Backs Bay
Cape Dalgety	72°01′	96°27′	not Cape Dalgetty
Inner Brown Bay	72°58′	98°15′	not Little Brown Bay
Name change			
Transition (Kennedy) Bay	72°02′	96°27′	not Kennedy Bay
Altered application			
Strzelecki Harbour	72°13′	96°32′	
Rescinded			
Transition Bay	72°02′	96°27′	
Colquhoun Range	72°10′	98°22′	

M'Clintock Channel 67 NW and 67 NE
(Adopted July 2, 1959)

Fisher River	71°53′N.	98°04′W.	
Name confirmation			
Willis Bay	71°54′	96°35′	not Willes Bay nor Wiltes Bay

Leo Islands 87 A/4
(Adopted July 2, 1959)

Leo Islands	68°08′N.	113°56′W.	not Manning Islands

Denis High Hill 107 C/11
(Adopted July 2, 1959)

Camp Farewell (locality)	69°16′N.	134°54′W.	
Denis Lake	69°20′	134°33′	
Denis Lagoon	69°22′	134°39′	
Denis High Hill	69°22′	134°43′	
Denis Pingo	69°19′	134°42′	
Big Horn Point	69°24′	134°50′	
Fish Island	69°22′	134°54′	
Seal Island	69°24′	134°52′	
Swan Channel	69°27′	134°39′	
Grassy Lake	69°15′	134°49′	
Pullen Lake	69°15′	134°41′	
Mid Lake	69°16′	134°33′	
Trapp Hills	69°17′	134°37′	
Big Lake	69°24′	134°56′	
Harry Channel	69°22′	134°56′	not Harry's Channel

Kidney Lake 107 E/6
(Adopted July 2, 1959)

Kidney Lake	70°03′N.	130°45′W.	

Coppermine 86 NW and 86 NE
(Adopted August 6, 1959)

Bebensee Lake	67°29′N.	118°32′W.	not Rock Lake

Porcupine River 116 J and 116 K (E½)
(Adopted August 6, 1959)

Terrace Ridge	66°15′N.	138°53′W.	
Bluefish Lake	66°52′	140°37′	
Whitestone Village (settlement)	66°24′	138°24′	not Whitestone (locality)

Great Slave 85 SE
(Adopted September 10, 1959)

Hawkes Lake	60°08′N.	114°26′W.	
Skillet Lake	60°06′	114°16′	
Higgins Lake	60°17′	113°46′	not Klewi Lake
Deschaine Lake	60°20′	115°38′	not Park Lake

Sibbeston Lake 95 G
(Adopted September 10, 1959)
Name confirmation

Jackfish Gap	61°05′N.	123°59′W.	

Ducot Peak 95 O/7
(Adopted September 10, 1959)

Willow Creek	63°21′N.	123°41′W.	
Philips Creek	63°20′	123°41′	
Moose Lakes	63°24′	123°57′	
Ducot Peak	63°18′	123°56′	

Fort Good Hope 106 I
(Adopted September 10, 1959)

Payne Creek	66°47′N.	129°58′W.	
Ramparts Plateau	66°37′	129°00′	

Arctic Red River 106 N
(Adopted September 10, 1959)
Name confirmations

Attoe Lake	67°25′N.	133°09′W.	not Tongue Lake
Dzien Die Lake	67°17′	133°06′	not Rat House Lake
Cardinal Lake	67°36′	133°36′	not Island Lake nor Cardinals Lake
Tsital Trein Creek	67°29′	133°34′	not Scissor Creek

Barrow Strait West 68 NW and 68 NE
(Adopted October 1, 1959)

Berkeley Strait	75°40′N.	96°35′W.	
Bracebridge Inlet	75°30′	100°30′	

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